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ABSTRACT

This document is a teacher's guide for a unit in vocational agriculture for college freshmen. It is intended to be used for 20 hours of instruction as an introductory course on the crop industry. It provides a broad background of the industry, including production, marketing, processing, and transportation, with emphasis on identifying major crops and their uses. It also covers the first phases of the production cycle. (Subsequent units in plant science and crop production build upon this unit.) The objectives of the unit are to help students to develop an understanding of the functioning of the crop industry; an ability to identify primary plant parts, major North Dakota crops and their uses, and prohibited and restricted noxious weeds; in addition to the ability to determine seed quality and to prepare seed for planting. The unit is divided into material for six jobs, as follows: (1) examining the crop industry; (2) identifying plant parts; (3) identifying major North Dakota crops and their uses; (4) identifying weeds; (5) determining seed quality; and (6) preparing seed for planting. Each of the jobs includes objectives, guide questions, references, an approach to interest students, key facts about the content of the material, worksheets, and transparency masters. (KC)

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INTRODUCTION TO CROP PRODUCTION

Unit A-7

by

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Department of Agricultural Education
North Dakota State University
Fargo, North Dakota

February 1981

In cooperation with
North Dakota State Board for Vocational Education
Carrol E. Burchinal, State Director
900 East Boulevard
Bismarck, North Dakota 58505

CE 029 638

U.S. DEPARTMENT OF HEALTH,
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Further appreciation is given to those institutions who granted permission for the use of artwork in developing transparancy masters.

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INTRODUCTION TO CROP PRODUCTION

Jobs Included

1. Examining the Crop Industry.
2. Identifying Plant Parts.
3. Identifying Major North Dakota Crops and Their Uses.
4. Identifying Weeds.
5. Determining Seed Quality.
6. Preparing Seed for Planting.

Intended Use

This unit is intended to provide about twenty hours of instruction to first year vocational agriculture students introducing the crop industry. It provides a broad background of the industry including production, marketing, processing, and transportation with emphasis on identifying major crops and their uses. It also covers the first phases of the production cycle. Subsequent units in plant science and crop production build upon this unit.

Unit Objectives

1. To develop an understanding of the functioning of the crop industry.
2. To develop the ability to identify primary plant parts.
3. To develop the ability to identify major North Dakota crops and their uses.
4. To develop the ability to identify prohibited and restricted noxious weeds.
5. To develop the ability to determine seed quality.
6. To develop the ability to prepare seed for planting.

References:

Basic Vocational Agriculture I. Vocational Instructional Services, Texas A & M University, College Station, Texas.

Berglund, Duane R. Order and Importance of Crop Judging Factors in North Dakota. Cooperative Extension Service, North Dakota State University, Fargo, North Dakota.

Contests, Awards And Activities Bulletin. North Dakota FFA Association, December 1977.

Delorit, Richard J., Louis J. Greub and Henry L. Ahlgren. Crop Production. Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1974.

Dungan, George H. and W. A. Ross. Growing Field Crops. New York, New York: McGraw-Hill Book Company, Inc., 1957.

Engel, Austin, Lynn Clancy, and Greg Lunde. Agricultural Processing Research. The Task Force on Agricultural Processing, 1980.

Introduction to Vocational Agriculture. California Vocational Agriculture Curriculum Guidelines, Vocational Education Productions, California Polytechnic State University, San Luis Obispo, California, 1977.

Messersmith, Calvin G. and Edward L. Deckard. Agronomy 103 Laboratory Guide. Agronomy Department, North Dakota State University, Fargo, North Dakota, 1976.

Messersmith, Calvin G. and Edward L. Deckard. Agronomy 103 Lecture Guide. Agronomy Department, North Dakota State University, Fargo, North Dakota, 1978.

Miller, Duane G., Gilbert A. Long, and Clarence E. Manning. Transparency Masters For Crop And Weed Identification. Washington State University, Pullman, Washington, 1968.

Mitch, Larry W. Identifying Weeds and Their Seeds. Cooperative Extension Service, North Dakota State University, Fargo, North Dakota.

1979 Handbook of Agricultural Charts. United States Department of Agriculture, Agriculture Handbook Number 561, Washington, D.C., October 1979.

North Dakota Agricultural Statistics 1980. North Dakota Crop and Livestock Reporting Service, North Dakota State University Agricultural Experiment Station and the U.S. Department of Agricultural Economics, Statistics and Cooperatives Service, Fargo, North Dakota, May 1980.

Job 1: Examining the Crop Industry.

Objectives:

The objectives of this job shall be met at a level predetermined by the instructor. The manner in which they are evaluated shall also be determined by the instructor.

Upon completion of this job, the students shall be able:

1. to understand the importance of the crop industry to the world, nation, state and local area.
2. to list and give examples of agronomic classifications of crops.
3. to list functions of the producer.
4. to list types of sales and service businesses and organizations.
5. to list where crops are marketed and transported.
6. to list basic steps in the processing of various crops.

Guide Questions:

1. What is the importance of the crop industry to the world, nation, state, and local area?
2. What are the agronomic classifications of crops?
3. How are most crops produced?
4. What types of sales and service businesses serve the crop industry?
5. How are crops marketed?
6. Where are most crops transported?
7. How are crops processed?

References:

Basic Vocational Agriculture I. Vocational Instructional Services, Texas A & M University, College Station, Texas.

Engel, Austin, Lynn Clancy, and Greg Lunde. Agricultural Processing Research. The Task Force on Agricultural Processing, 1980.

Introduction to Vocational Agriculture. California Vocational Agriculture Curriculum Guidelines, Vocational Education Productions, California Polytechnic State University, San Luis Obispo, California, 1977.

Messersmith, Calvin G. and Edward L. Deckard. Agronomy 103 Lecture Guide. Agronomy Department, North Dakota State University, Fargo, North Dakota, 1978.

1979 Handbook Of Agricultural Charts. United States Department of Agriculture, Agricultural Handbook Number 561, Washington, D.C., October 1979.

North Dakota Agricultural Statistics 1980. North Dakota Crop and Livestock Reporting Service, North Dakota State University Agricultural Experiment Station and the U.S. Department of Agricultural Economics, Statistics and Cooperatives Service, Fargo, North Dakota, May 1980.

Interest Approach:

Have the students name an animal and trace each one back in the food chain to a plant. Do this several times to point out the importance of plants and the crop industry.

Key Facts:

I. Importance of the Crop Industry.

   A. Worldwide.

      1. Basic source of food for all humans.

         a. Convert light energy from the sun to usable energy for consumption.
         b. Plants are always the first link in the food chain.

      2. Provides numerous other things.

         a. Fuels.
         b. Medicines and drugs.
         c. Fabrics.
         d. Paper.
         e. Prevent wind and water erosion.
         f. Habitat for wildlife.

   B. National. (1979 Information)

      1. Consumption of crop products increased rapidly since 1967. (Transparency 1)

      2. No country can compete with the U.S. in quantity and quality of food produced.

a. West Germany is the only major country which spends a smaller percentage of income on food. (Transparency 2)
b. U.S.S.R. only country to produce more wheat. (Transparency 3)
c. U.S. leading producer of soybeans. (Transparency 4)
d. U.S.S.R. only country to produce more sunflowers. (Transparency 5)

3. World grain production has increased faster than U.S. production largely due to increased technology in underdeveloped countries. (Transparency 6)

4. U.S. is the leading exporter of grain and fiber.

a. Oil seeds and products.

1) U.S. exports high percentage of total world sunflower seed. (Transparency 7)
2) U.S. largest exporter of soybeans.

b. Wheat and flour. (Transparency 8)
c. Feed grains. (Transparency 9)
d. Cotton. (Transparency 10)
e. Rice. (Transparency 11)
f. Fruits and vegetables.

5. U.S. is a leader in agricultural research, technology, and education.

C. North Dakota. (1979 figures)

1. Crop industry is largest in the state.

2. Leading producer of small grains in nation. (Transparency 12)

a. First in spring wheat - 39% of nation's total production.
b. First in durum wheat - 79%.
c. First in barley - 20%.
d. Second in all wheat - 12%.
e. Second in rye - 21%.
f. Fifth in oats - 7%.

3. Major producer of many other crops. (Transparency 13)

a. First in flaxseed - 47%.
b. First in sunflowers - 63%.
c. First in proso millet - (1979 figure not available, 56% in 1974).
d. First in mustard seed - (1979 figure not available, 64% in 1974).
e. Fourth in sugarbeets - 10%.
f. Sixth in potatoes - 5%.

g. Sixth in dry edible beans - 7%.
h. Seventh in alfalfa hay - 4%.
i. Ninth in all hay - 4%.

4. 95 percent of total N.D. land area is in farms. 60 percent of total is cropland.

D. Locally. (Transparencies 14-35)

1. Total county production of various crops.

a.
b.
c.
d.

2. Average county yield for various crops.

a.
b.
c.
d.

3. Other.

a.
b.
c.
d.

II. Agronomic Classification of Crops.

A. Cereals.

1. Belong to the grass family.

2. Grown for their edible seed.

3. Often called grain.

4. Examples.

a. Wheat.
b. Oats.
c. Barley.

B. Forages.

1. Any plant consumed by livestock.

2. Types.

a. Pasture.
b. Hay.

      c. Silage - allowed to ferment to preserve the forage.
      d. Haylage - similar to silage.
      e. Soilage - cut and fed when green without curing.

C. Oil crops.

   1. Grown for edible and/or industrial oil.

   2. Examples.

      a. Sunflowers.
      b. Soybeans.
      c. Flax.

D. Sugar crops.

   1. Grown for sugar.

   2. Examples.

      a. Sugarbeets.
      b. Sugarcane.

E. Pulses.

   1. Legume plant.

   2. Grown for edible seed.

   3. Examples.

      a. Dry edible beans.
      b. Peas.

F. Fiber crops.

   1. Grown for commercial use of fiber.

   2. Examples.

      a. Cotton.
      b. Flax.

G. Green manure.

   1. Grown and plowed under to improve soil condition.

   2. May be in combination with another use.

H. Catch or emergency.

   1. Short season crop.

   2. Used when regular crop failed or planting was delayed.

I. Cover crop.

1. Seeded to protect soil from wind and water erosion.

2. May be in combination with another use.

J. Companion crop.

1. Small grain grown along with a slow-growing, later maturing crop, such as oats with sweetclover.

2. Also called nurse crop.

III. Production of Crops.

A. Small grains.

1. Generally planted in spring and harvested in late summer.

2. Winter varieties planted in fall, overwintered, and then harvested in early summer.

3. Narrow row spacings.

4. Most in N.D. are cut and put in a swath first, then combined, sometimes straight combined, as is done further south.

B. Row crops.

1. Generally planted in spring and harvested in fall.

2. Row spacing varies depending on type of plant.

3. Usually cultivated once or twice after sprouting to remove weeds between rows.

4. Most are harvested straight, some may be swathed first.

C. Forages.

1. May be planted in the spring, fall, or grown continuously.

2. Various methods of harvesting.

a. Cut, allowed to dry, and baled.
b. Cut, allowed to dry, and put up loose in a stack.
c. Cut, chopped, piled up, and allowed to ferment.
d. Cut and fed directly.
e. Cut, dried, ground, and pelleted.
f. Grazed.

IV. Sales and Service Businesses in the Crop Industry.

A. Provide goods and services to producers and others.

B. Include following areas.

1. Sales.

    a. Seed.
    b. Fertilizer.
    c. Pesticides.
    d. Machinery and equipment.
    e. Fuel.
    f. Supplies.
    g. Other.

2. Custom operations.

    a. Chemical application.
    b. Harvesting.
    c. Transportation.
    d. Irrigation.
    e. Drying.
    f. Tillage.
    g. Haying.

3. Lending institutions.

    a. Commercial banks.
    b. Federal Land Bank.
    c. Production Credit Association.
    d. Farmers Home Administration.
    e. Finance companies.
    f. Credit unions.

4. Educational services.

    a. May be provided by Cooperative Extension Service, Vocational Agriculture personnel, or other professionals.
    b. Services in many areas.

        1) Soil and water.
        2) Crop production.
        3) Marketing and statistics.
        4) Insects, weeds and diseases.
        5) Other.

5. Other services.

    a. Machinery and equipment repair.
    b. Soil testing.
    c. Seed cleaning.

V. Marketing of Crops.

A. Most crops sold to local elevator.

1. Small grains.

a. Wheat.
b. Barley.
c. Oats.
d. Durum wheat.
e. Rye.
f. Others.

2. Row crops.

a. Soybeans.
b. Oil type sunflowers.

3. Producers often contract before the crop is harvested.

B. Some crops generally only sold to a processor.

1. Sugarbeets.

2. Potatoes.

3. Non-oil type sunflowers.

4. Usually have a contract before growing crop.

C. Most forages are used by the producer for feed.

1. Most of what is sold is sold privately to livestock producers.

2. Some sold to processors.

VI. Transportation From Commercial Storage.

A. Method.

1. Rail.

a. Crops shipped primarily by rail.

1) Wheat.
2) Durum.
3) Barley.

b. Used to a greater extent in NW part of state.

2. Truck.

a. Crops shipped primarily by truck.

1) Oats (formerly by rail).
2) Sunflowers.
3) Flax.

b. Used more in eastern and southern part of state.

B. Destination.

1. Crops shipped primarily to Duluth-Superior.

a. Wheat.
b. Durum.
c. Sunflowers.

2. Crops shipped primarily to Minneapolis-St. Paul.

a. Oats.
b. Barley.
c. Flax.
d. Large amount of wheat also.

3. Much of the wheat and oats from western part of state goes west.

VII. Processing of Crops.

A. Flour milling.

1. Cleaned to remove weed seeds and foreign material.

2. Washed.

3. Tempered - raises moisture content to make milling easier.

4. Milling.

a. Grain is cracked and crushed.
b. Sifted to remove proper size particles.
c. Process repeated several times.

5. Grains which are milled.

a. Hard red spring wheat - used in baking bread.
b. Durum - produces seminola used in making macaroni and spaghetti.
c. Corn - corn flour, corn meal, grits.
d. Oats - used in cereals, soups, and baby foods.
e. Rye - used in rye bread and Ry-Krisp.
f. Sorghum.
g. Buckwheat - used in soups and pancakes.

B. Malting - converts starch to sugar.

1. Grain is cleaned.

2. Steeping - soaked in water.
3. Germination - allowed to sprout the length of the kernel.
4. Kilning - dried to stop germination at maximum sugar content.
5. Uses of barley malt.
    a. Beer.
    b. Industrial alcohol.
    c. Malt syrup.
6. Byproducts used mostly for livestock feed.

C. Oil extraction.

1. Cleaned and dried.
2. Crushed and heated.
3. Solvent usually used to extract oil, sometimes only pressure.
4. Solvent removed from oil by distilling.
5. Oil may be edible or industrial.
6. Leftover meal used as a protein supplement for livestock.

D. Sugarbeet processing.

1. Trash and stones removed and beets are washed.
2. Cut into thin slices similar to shoestring potatoes.
3. Soaked in hot water to dissolve sugar.
4. Series of straining and evaporating.
5. Remaining syrup is heated to cause crystallization.
6. Leftover is removed and reprocessed leaving sugar.
7. Byproducts generally fed to livestock.
8. Sugarcane processing is similar but involves a two-step refining process.

E. Amount of processed potato consumption is increasing. (Transparency 36)

1. Chips.
2. Shoestring.
3. Various kinds of frozen.

F. Packaging.

1. Wide variety of methods used.

2. Include some of the following:

    a. Canned.
    b. Bagged.
    c. Boxed.
    d. Frozen.
    e. Dried.
    f. Precooked.
    g. Raw.

G. Location of processing in North Dakota.

1. Malting.

    a. Spiritwood.
    b. Moorhead, Minnesota.

2. Sugarbeets.

    a. Drayton.
    b. Hillsboro.
    c. Wahpeton.
    d. Crookston, Minnesota.
    e. Moorhead, Minnesota.
    f. East Grand Forks, Minnesota.

3. Sunflowers.

    a. West Fargo.
    b. Hankinson.
    c. Velva.

4. Wheat.

    a. Grand Forks - milling.
    b. Cando - pasta processing.
    c. Jamestown - frozen bread dough.
    d. Fargo - flour, cereal, and pizza crust.

5. Potatoes.

    a. Grand Forks.
    b. Number of products.

        1) Potato flour.
        2) French fries.
        3) Potato chips.
        4) Hash browns.

Student Learning Activities:

1. Have students select a particular crop and report on the production, marketing, processing and consumption of it.

2. Show any of the following films:

   North Dakota State Film Library, Fargo, North Dakota.

   American Farming - Yesterday and Today.
   Durum - Standard of Quality.
   Farmers In A Changing America.
   Food For A Modern World.
   Grist Miller.
   Hard Red Spring Wheat.
   North Dakota Wheat In World Trade.
   Story Of Potatoes.
   Wheat-Field To Flour.

   North Dakota State Board for Vocational Education, Bismarck, North Dakota.

   What Is Agriculture?

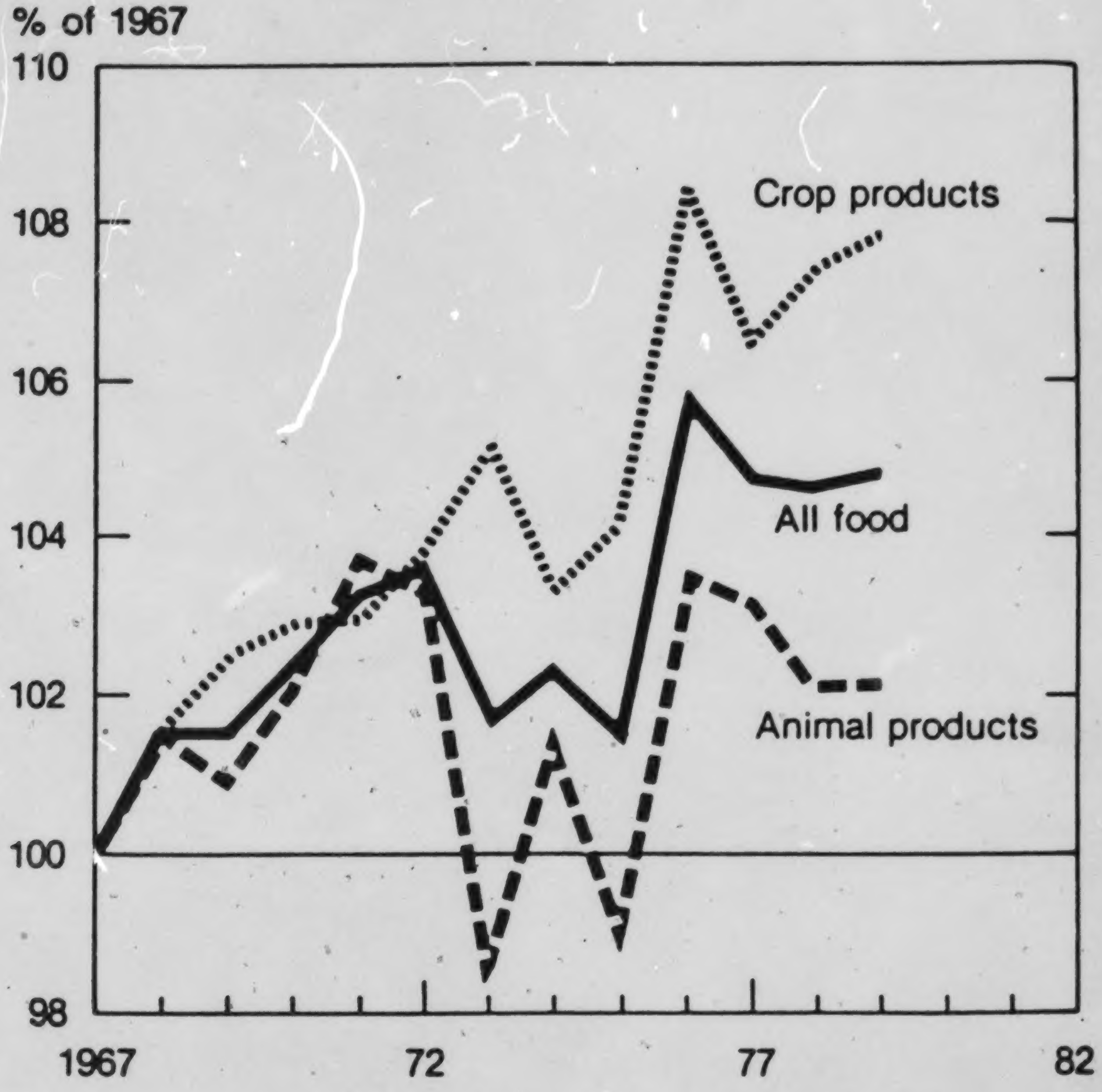
   Farm Film Foundation, Washington, D.C.

   Wheat: Making The World Grow.

   Modern Talking Picture Service, St. Petersburg, Florida.

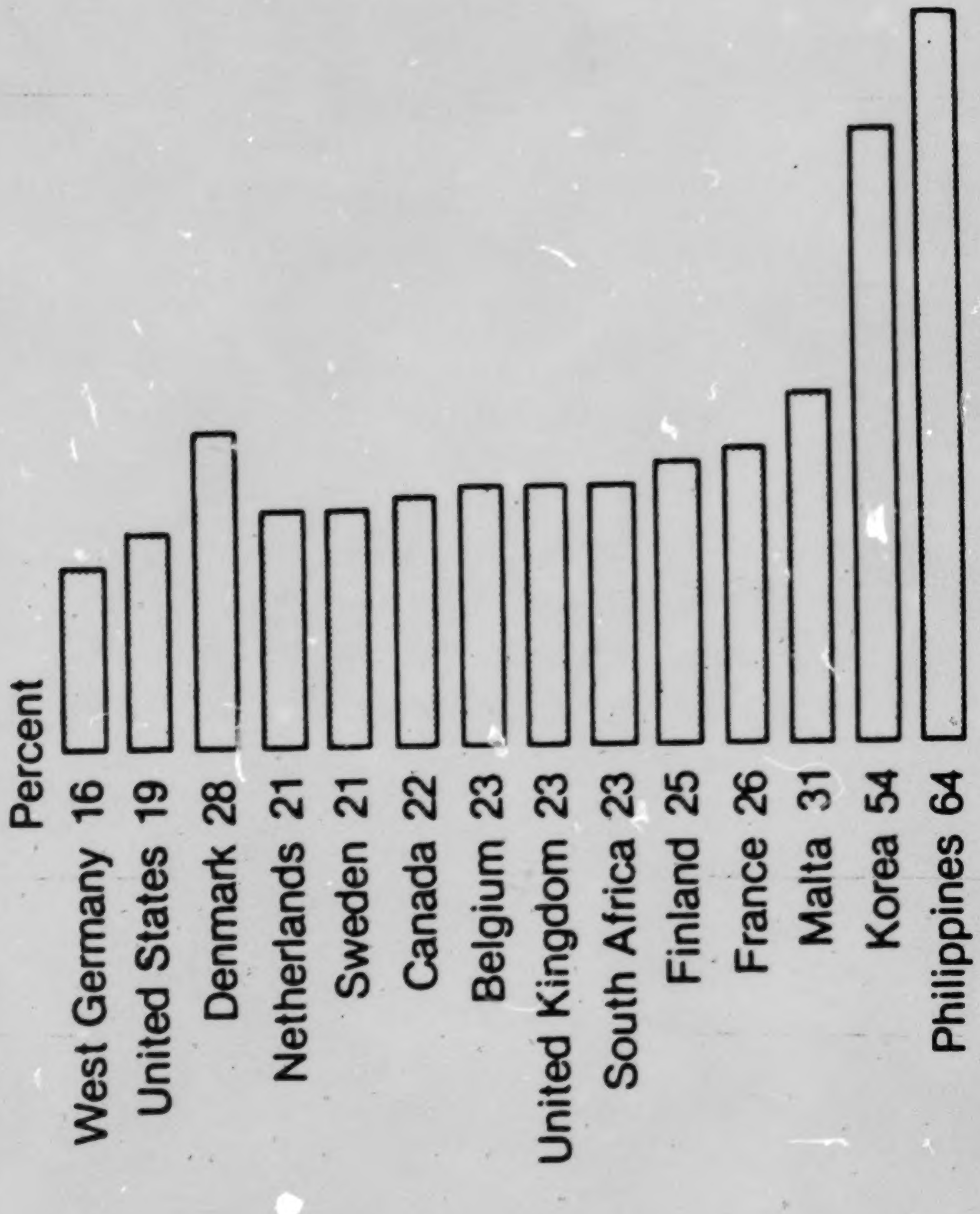
   Today's Choice.

Per Capita Food Consumption



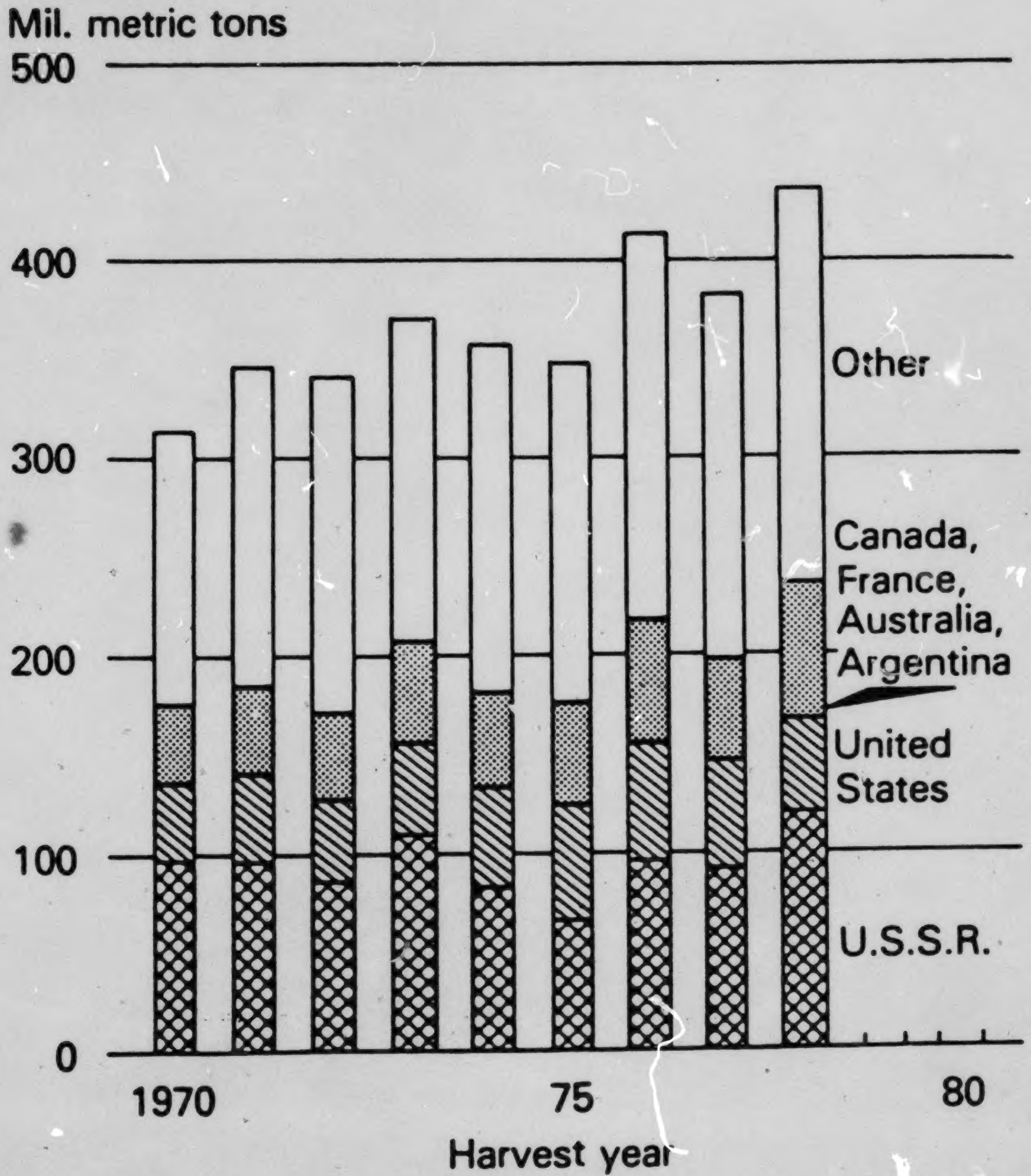
Source: 1979 Handbook of Agricultural Charts. United States Department of Agriculture.

Share of After-Tax Income Spent on Food



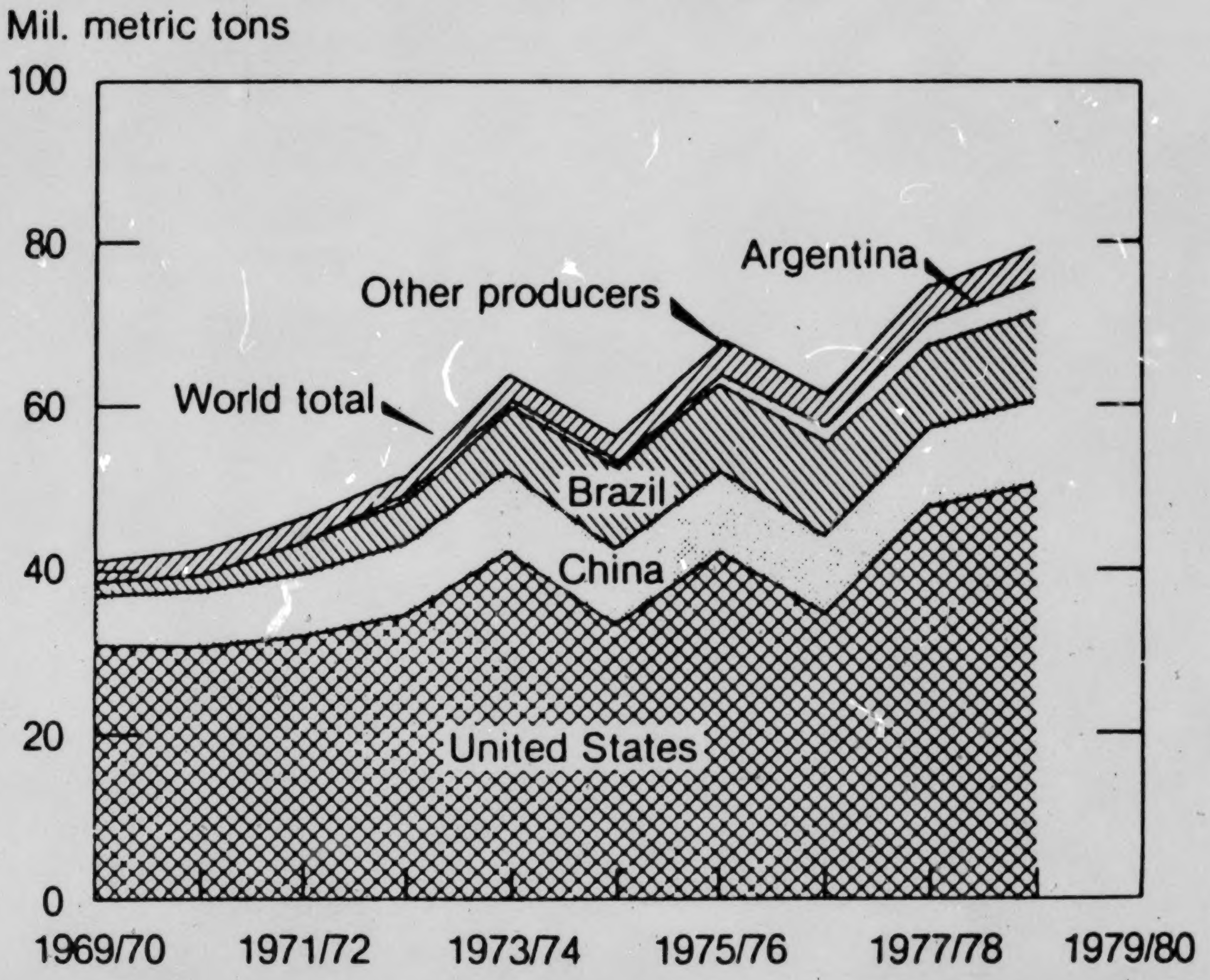
Source: 1979 Handbook of Agricultural Charts. United States Department of Agriculture.

Where the World's Wheat Is Grown



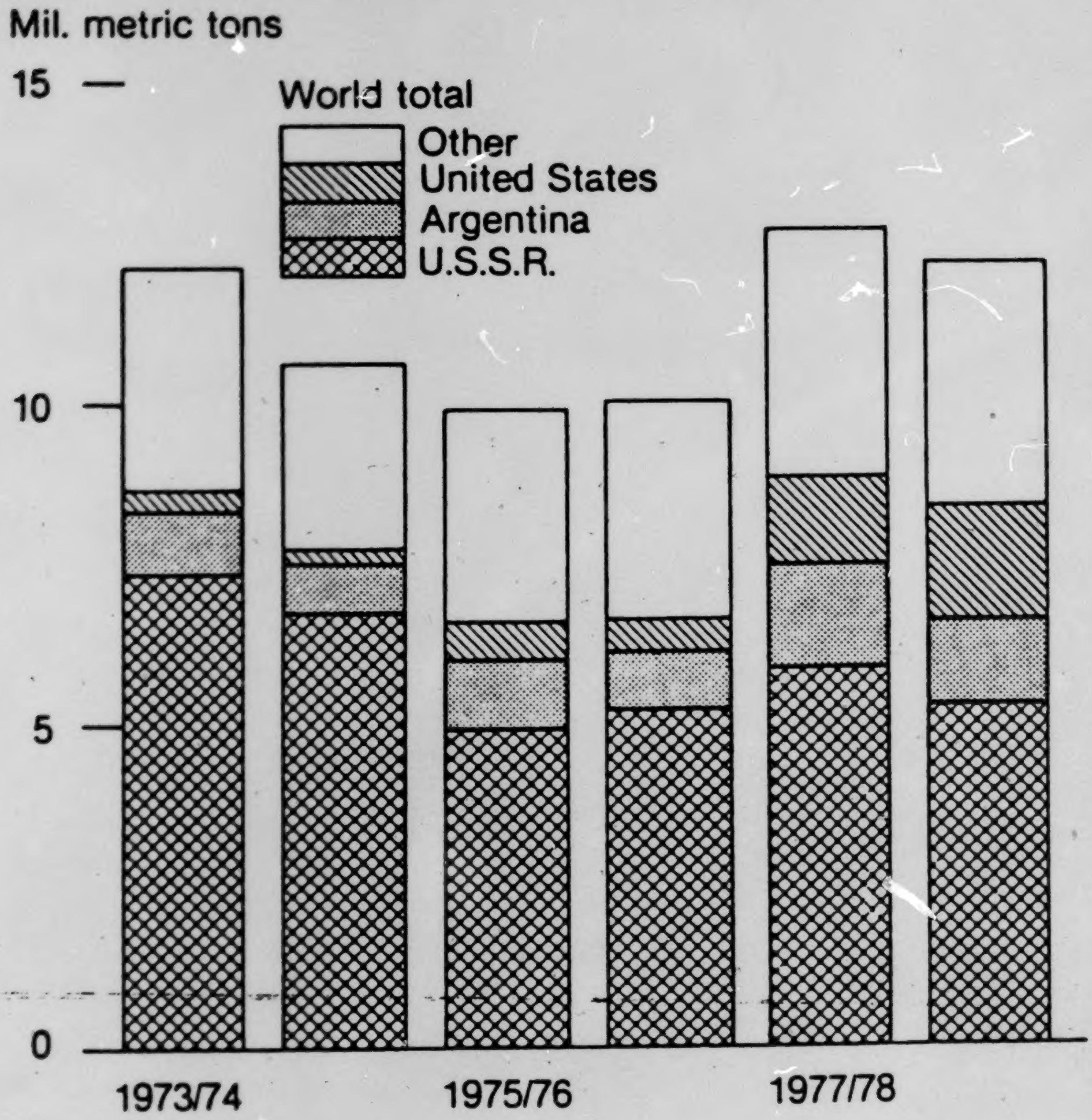
Source: 1979 Handbook of Agricultural Charts. United States Department of Agriculture.

Where the World's Soybeans are Grown



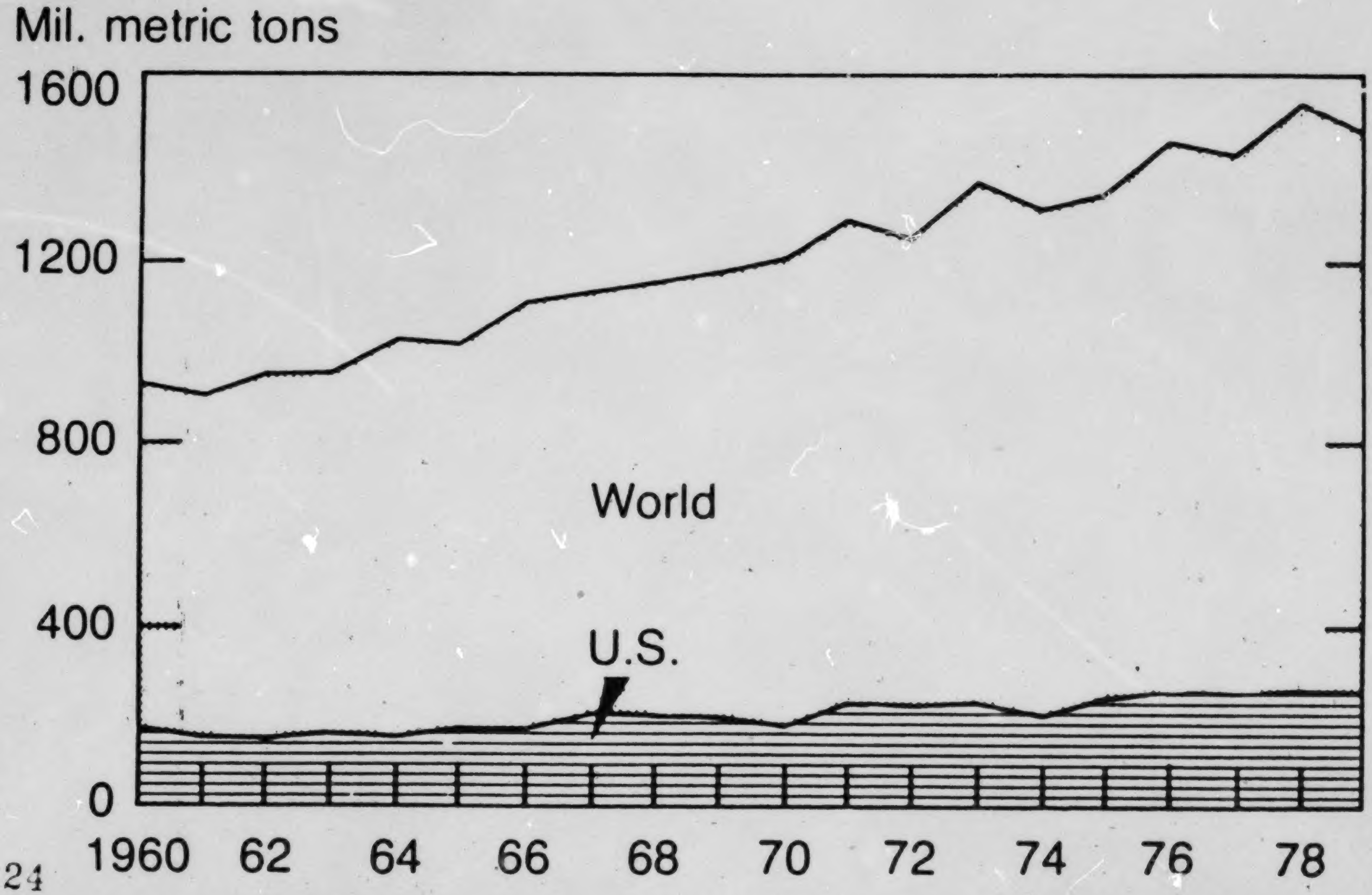
Source: 1979 Handbook of Agricultural Charts. United States Department of Agriculture.

World Production of Sunflowerseed



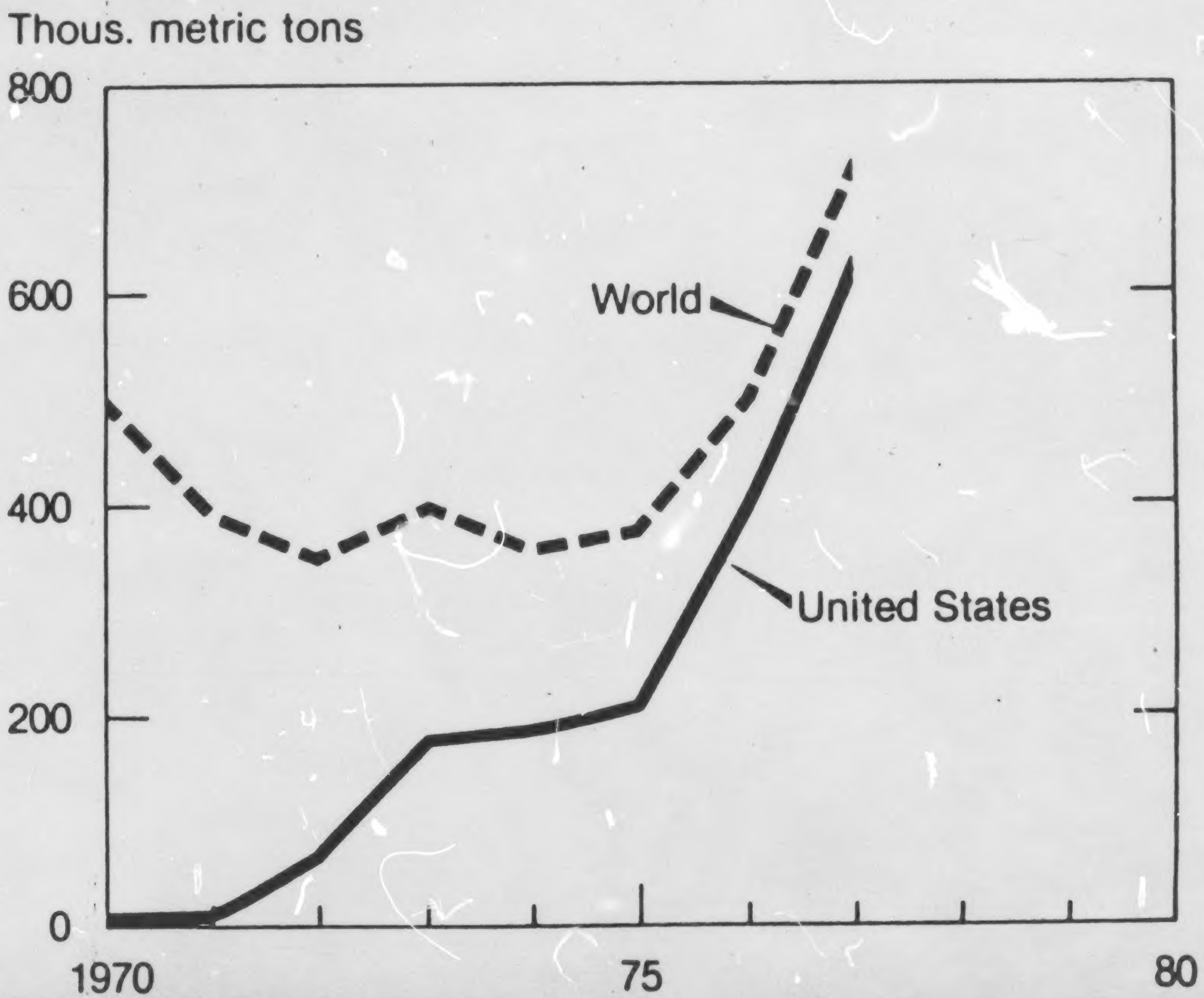
Source: 1979 Handbook of Agricultural Charts. United States Department of Agriculture.

TOTAL GRAIN PRODUCTION



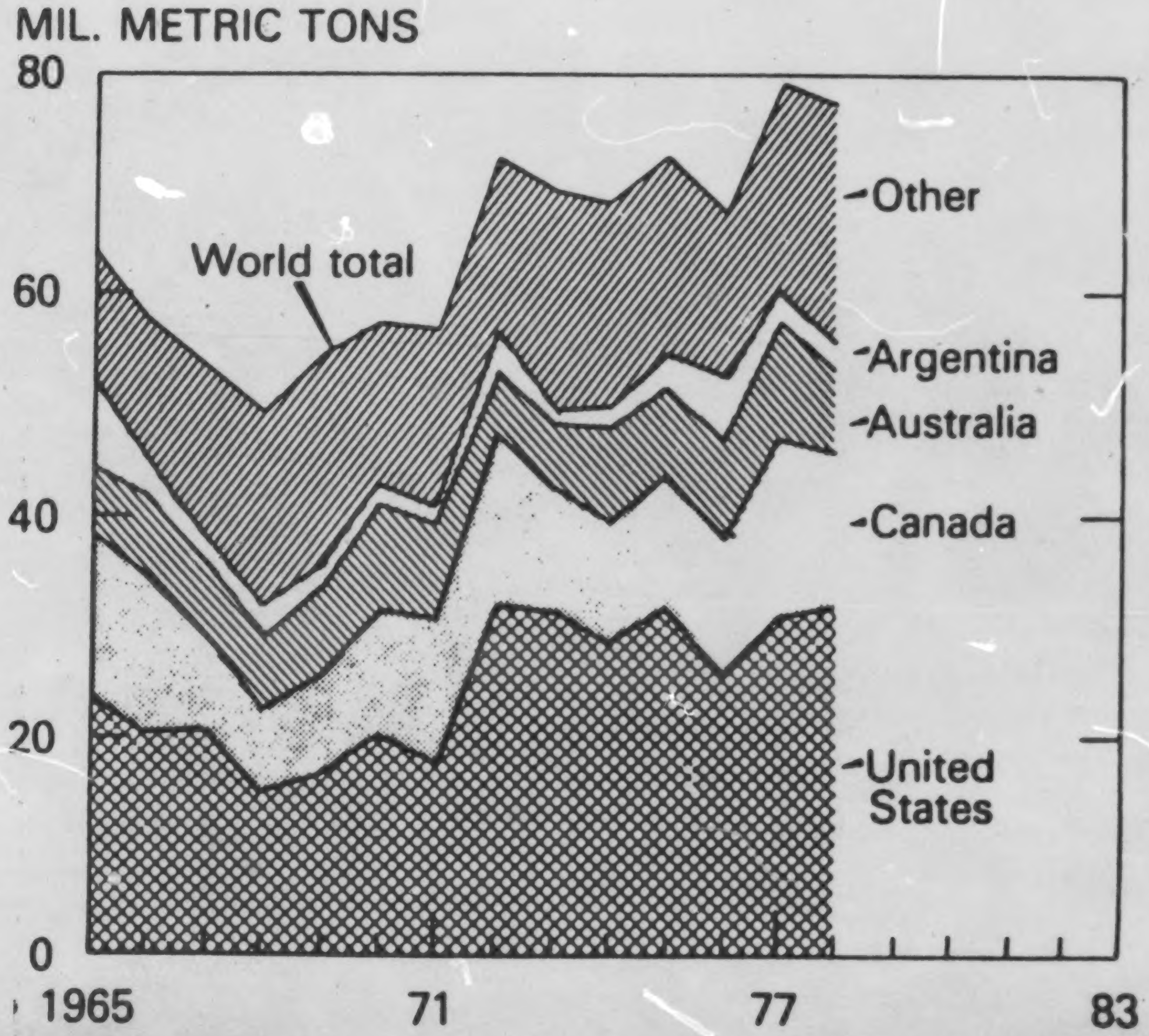
Source: 1979 Handbook of Agricultural Charts. United States Department of Agriculture.

World and U.S. Exports of Sunflowerseed



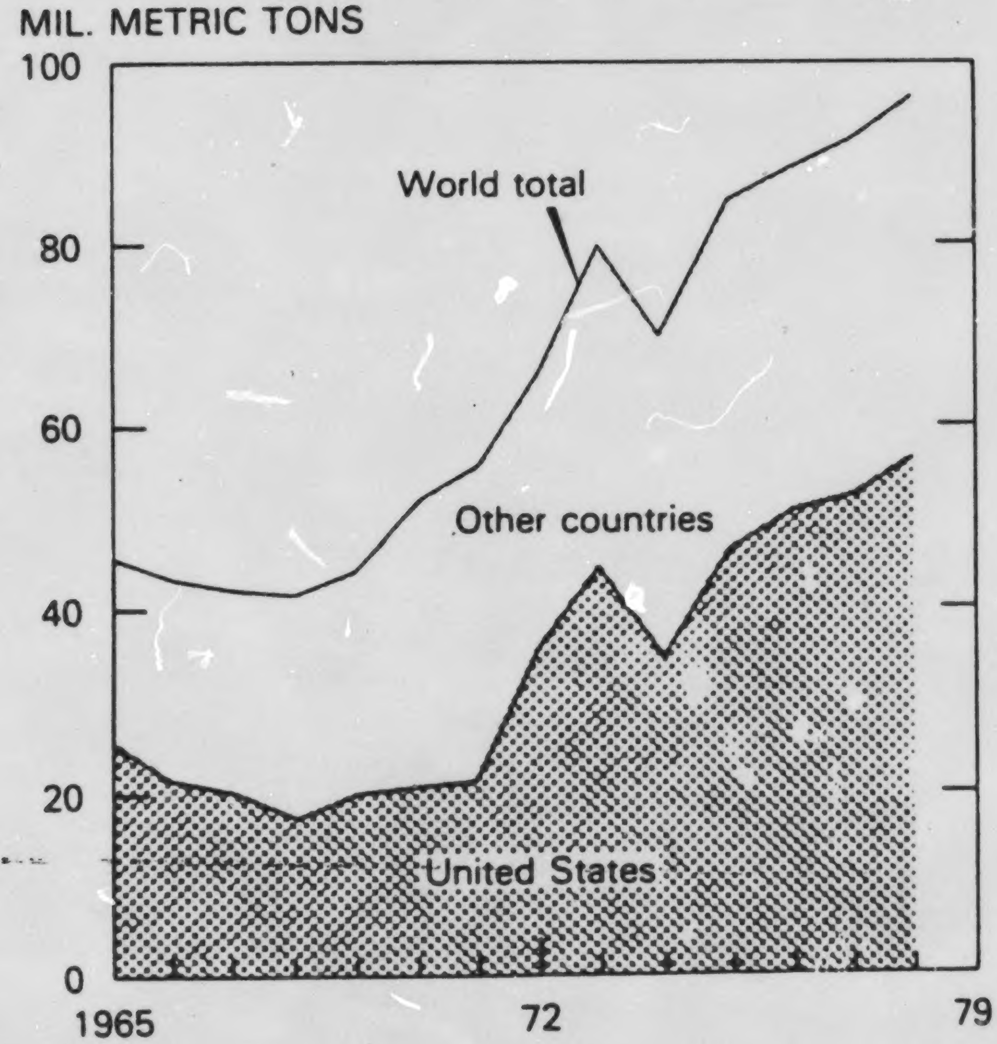
Source: 1979 Handbook of Agricultural Charts. United States Department of Agriculture.

Major Wheat and Flour Exporters



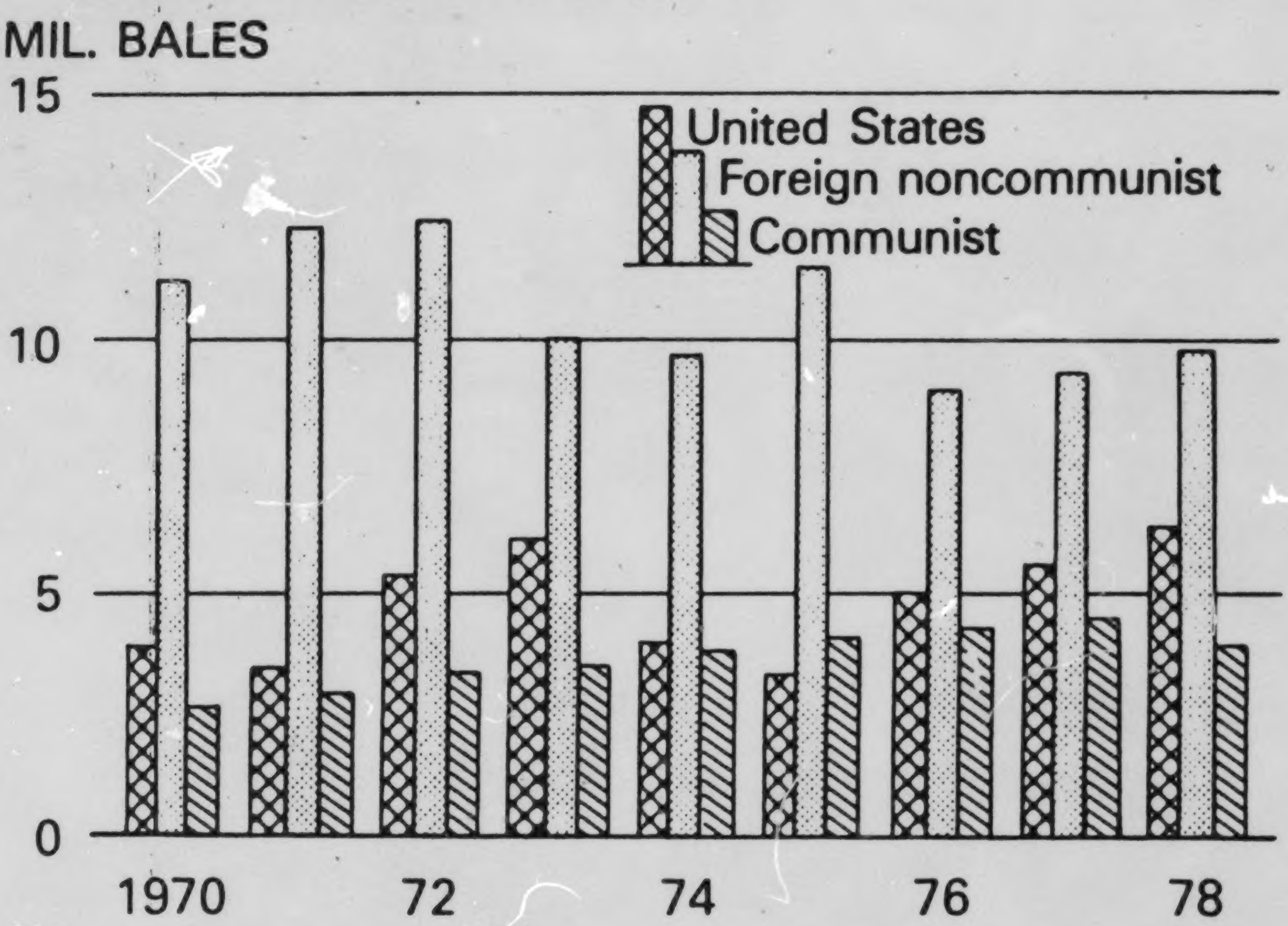
Source: 1979 Handbook of Agricultural Charts. United States Department of Agriculture.

WORLD EXPORTS OF FEED GRAINS



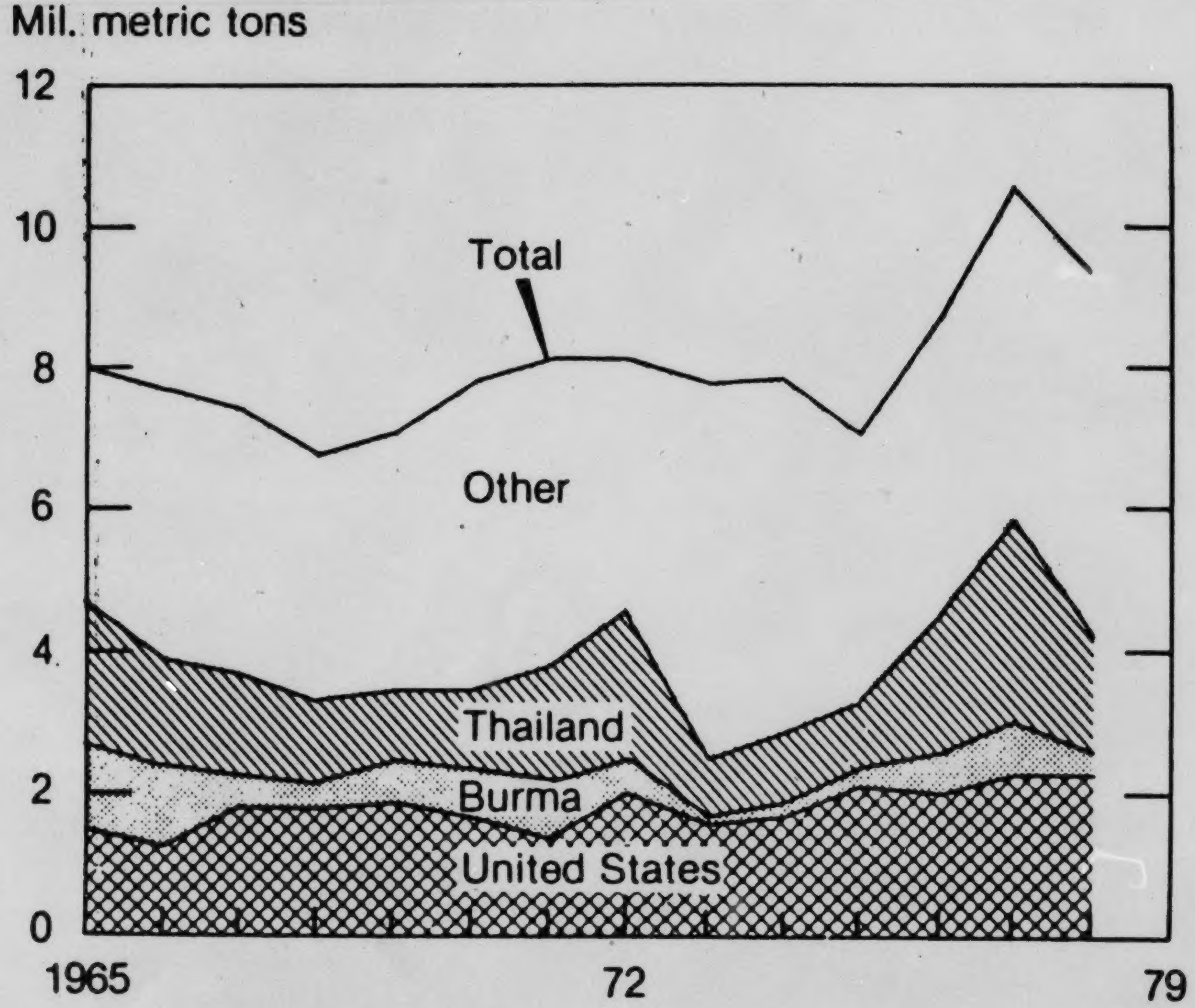
Source: 1979 Handbook of Agricultural Charts. United States Department of Agriculture.

World Cotton Exports



Source: 1979 Handbook of Agricultural Charts. United States Department of Agriculture.

World's Major Rice Exporting Countries



Source: 1979 Handbook of Agricultural Charts. United States Department of Agriculture.

NORTH DAKOTA IS THE LEADING PRODUCER OF SMALL GRAINS

1979

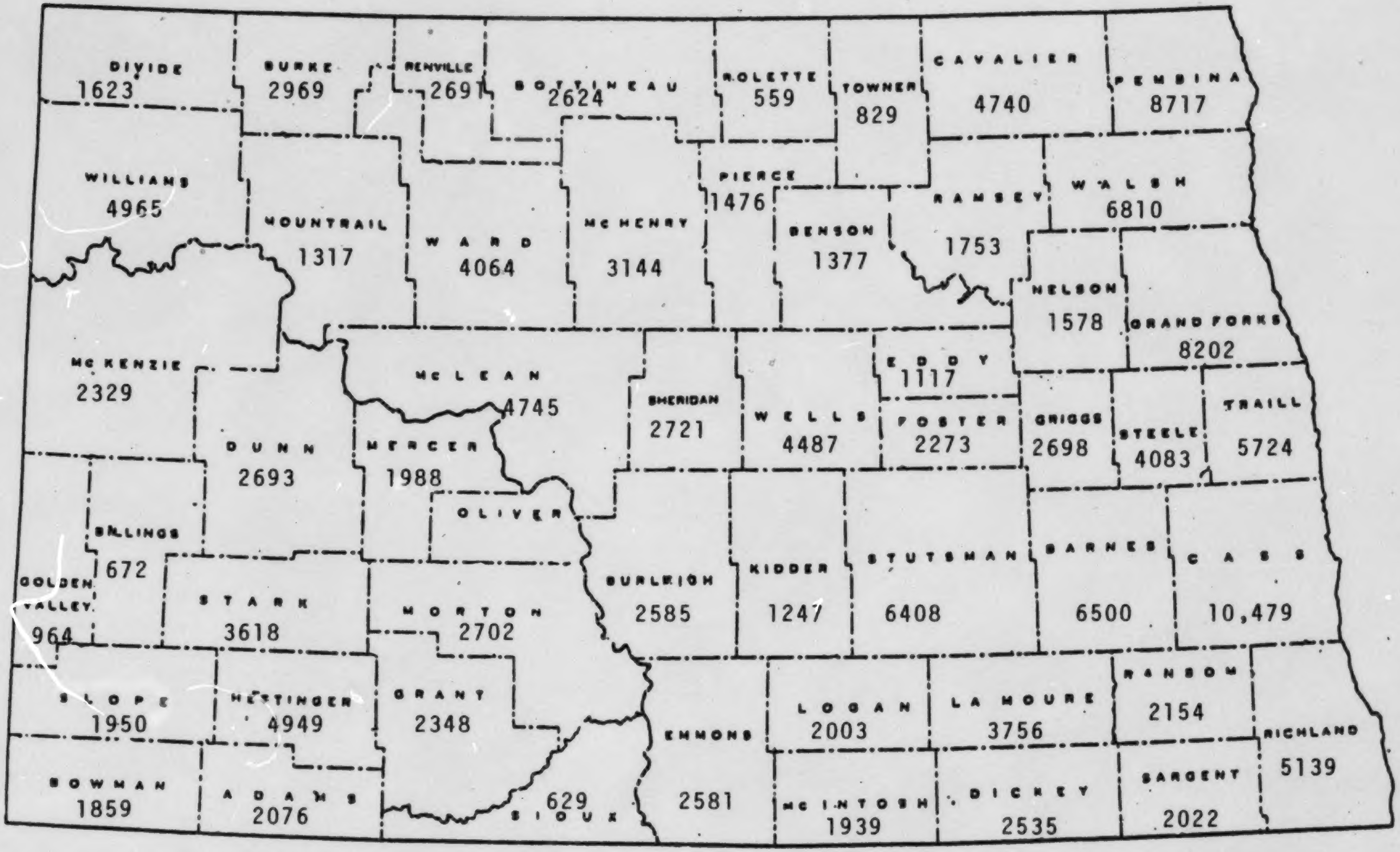
FIRST IN SPRING WHEAT	39%
FIRST IN DURUM WHEAT	79%
FIRST IN BARLEY	20%
SECOND IN ALL WHEAT	12%
SECOND IN RYE	21%
FIFTH IN OATS	7%

NORTH DAKOTA IS A MAJOR PRODUCER OF MANY OTHER CROPS

1979

FIRST IN FLAXSEED	47%
FIRST IN SUNFLOWERS	63%
FIRST IN PROSO MILLET	56%
FIRST IN MUSTARD SEED	64%
FOURTH IN SUGAR BEETS	10%
SIXTH IN POTATOES	5%
SIXTH IN DRY EDIBLE BEANS	7%
SEVENTH IN ALFALFA HAY	4%
NINTH IN ALL HAY	4%

SPRING WHEAT PRODUCTION BY COUNTY
1974 - 1978 AVERAGE (THOUSAND BUSHELS)


DIVIDE
1623
BURKE
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RENVILLE
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BOTTINEAU
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ROLETTE
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TOWNER
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CAVALIER
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PEMBINA
8717
WILLIAMS
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MOUNTRAIL
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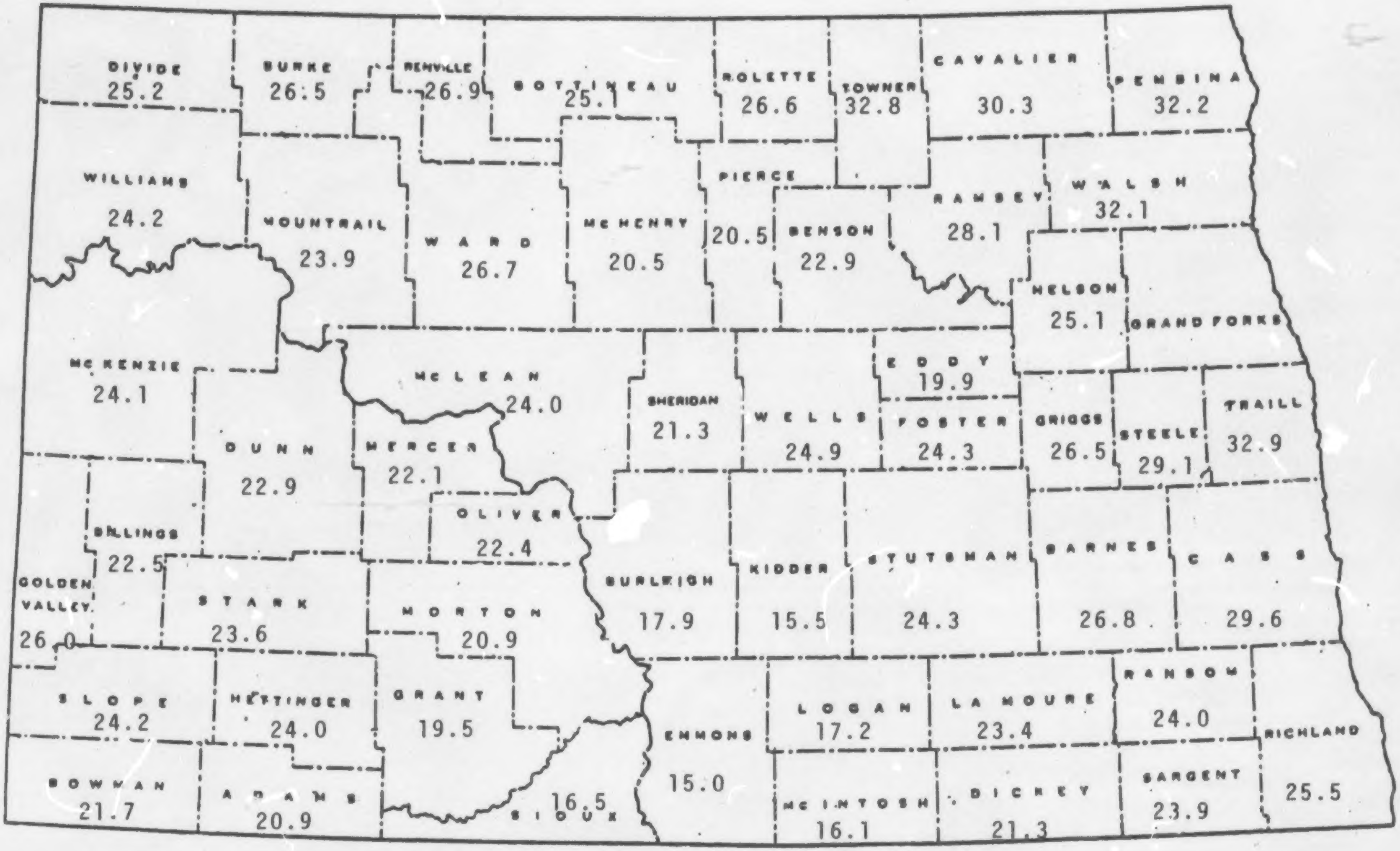
SLOPE
1950
HETTINGER
4949
GRANT
2348
EMMONS
2581
LOGAN
2003
LA MOURE
3756
RANSOM
2154
RICHLAND
5139
BOWMAN
1859
ADAMS
2076
629
SIOUX
McINTOSH
1939
DICKEY
2535
SARGENT
2022

SPRING WHEAT YIELD BY COUNTY
1974 - 1978 AVERAGE (BUSHELS)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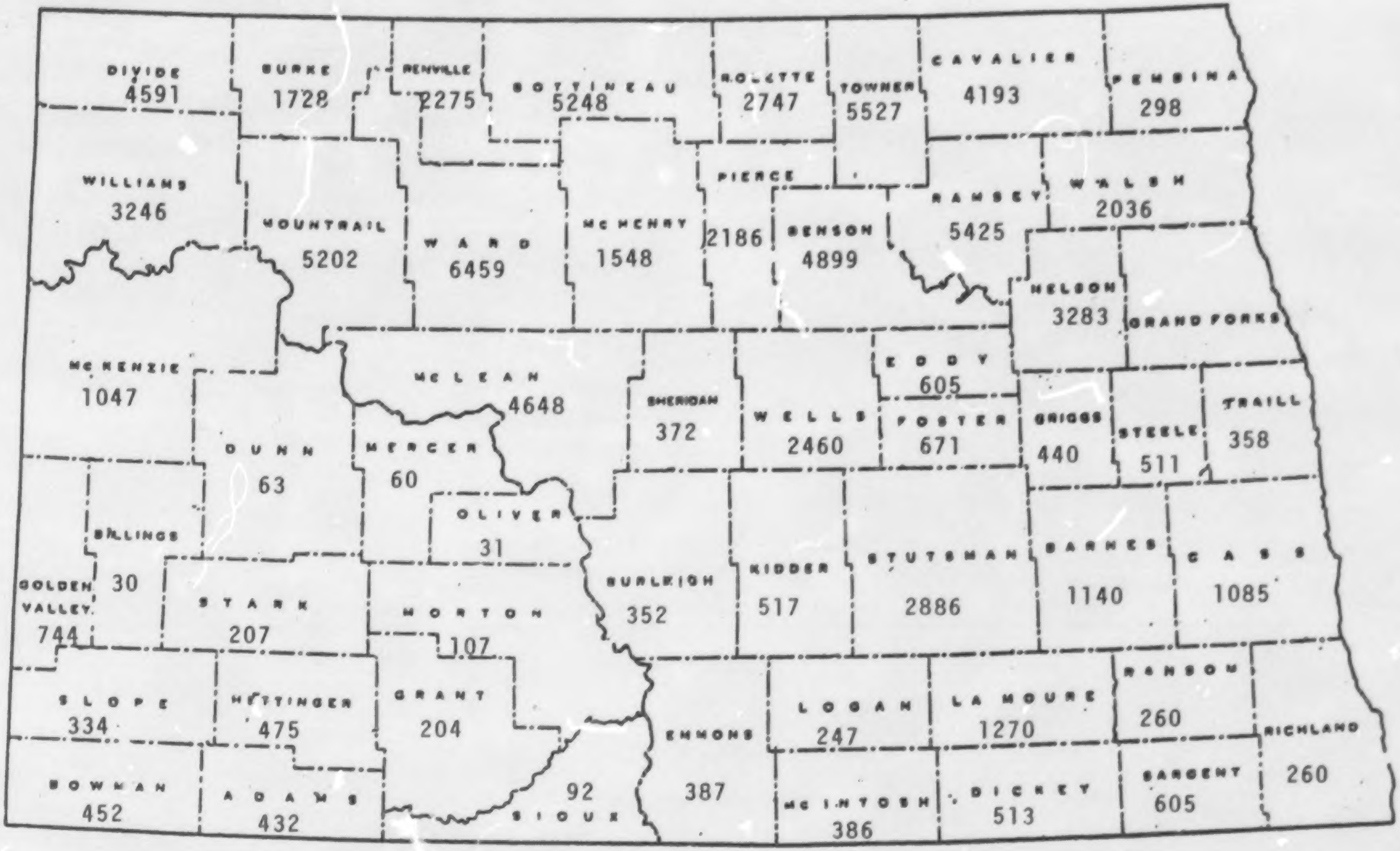
BURKE 26.5
RENVILLE 26.9
BOTTINEAU 25.1
ROLETTE 26.6
TOWNER 32.8
CAVALIER 30.3
PEMBINA 32.2
WILLIAMS 24.2
MOUNTRAIL 23.9
WARD 26.7
McHENRY 20.5
PIERCE 20.5
BENSON 22.9
RAMSEY 28.1
WALSH 32.1
NELSON 25.1
GRAND FORKS
McKENZIE 24.1
McLEAN 24.0
SHERIDAN 21.3
WELLS 24.9
EDDY 19.9
FOSTER 24.3
GRIGGS 26.5
STEELE 29.1
TRAILL 32.9
DUNN 22.9
MERCER 22.1
OLIVER 22.4
BILLINGS 22.5
GOLDEN VALLEY 26.0
STARK 23.6
MORTON 20.9
BURLEIGH 17.9
KIDDER 15.5
STUTSMAN 24.3
BARNES 26.8
CASS 29.6
SLOPE 24.2
HETTINGER 24.0
GRANT 19.5
EMMONS 15.0
LOGAN 17.2
LA MOURE 23.4
RANSOM 24.0
RICHLAND 25.5
BOWMAN 21.7
ADAMS 20.9
SIOUX 16.5
McINTOSH 16.1
DICKEY 21.3
SARGENT 23.9

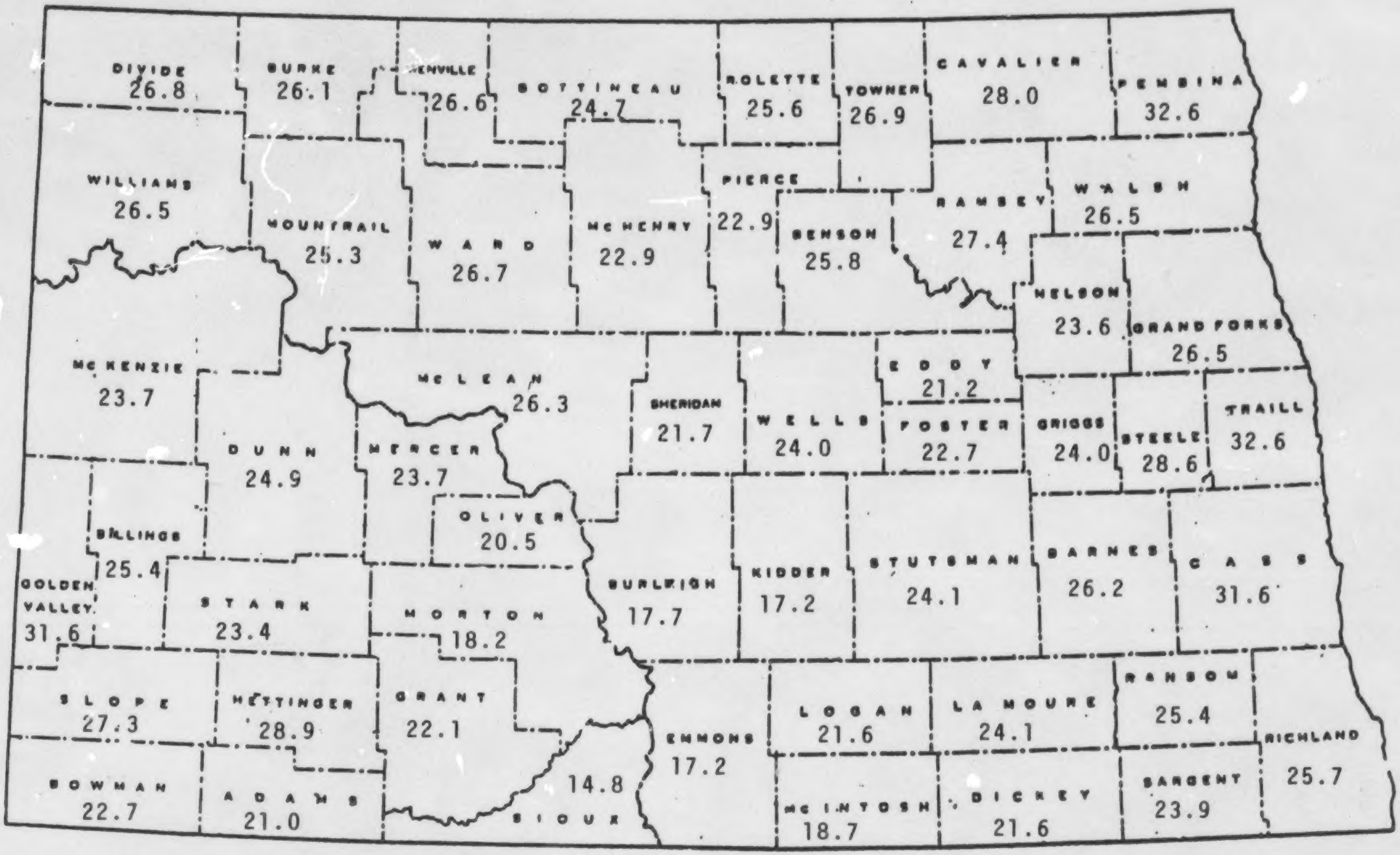
DURUM WHEAT PRODUCTION BY COUNTY

1974 - 1978 AVERAGE (THOUSAND BUSHELS)


DIVIDE 4591
BURKE 1728
RENVILLE 2275
BOTTINEAU 5248
ROLETTE 2747
TOWNER 5527
CAVALIER 4193
PEMBINA 298
WILLIAMS 3246
MOUNTRAIL 5202
WARD 6459
McHENRY 1548
PIERCE 2186
BENSON 4899
RAMSEY 5425
WALSH 2036
NELSON 3283
GRAND FORKS
McKENZIE 1047
McLEAN 4648
SHERIDAN 372
WELLS 2460
EDDY 605
FOSTER 671
GRIGGS 440
STEELE 511
TRAILL 358
DUNN 63
MERCER 60
OLIVER 31
BILLINGS 30
GOLDEN VALLEY 744
STARK 207
MORTON 107
BURLEIGH 352
KIDDER 517
STUTSMAN 2886
BARNES 1140
CASS 1085
SLOPE 334
HETTINGER 475
GRANT 204
EMMONS 387
LOGAN 247
LA MOURE 1270
RANSOM 260
RICHLAND 260
BOWMAN 452
ADAMS 432
SIOUX 92
McINTOSH 386
DICKEY 513
SARGENT 605

DURUM WHEAT YIELD BY COUNTY

1974 - 1978 AVERAGE (BUSHELS)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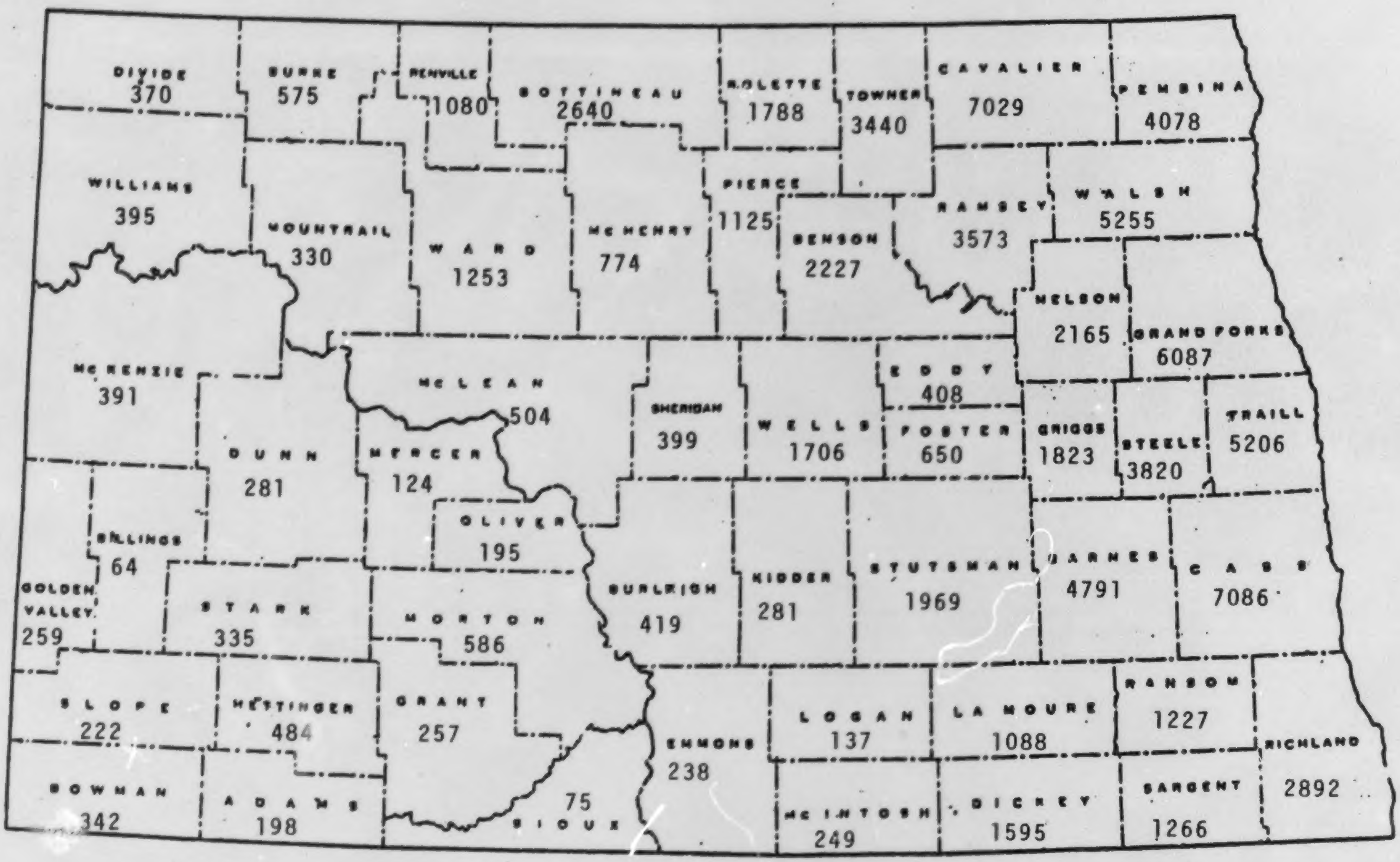
ROLETTE 25.6
TOWNER 26.9
CAVALIER 28.0
PEMBINA 32.6
WILLIAMS 26.5
MOUNTRAIL 25.3
WARD 26.7
McHENRY 22.9
PIERCE 22.9
BENSON 25.8
RAMSEY 27.4
WALSH 26.5
NELSON 23.6
GRAND FORKS 26.5
McKENZIE 23.7
McLEAN 26.3
SHERIDAN 21.7
WELLS 24.0
EDDY 21.2
FOSTER 22.7
GRIGGS 24.0
STEELE 28.6
TRAILL 32.6
DUNN 24.9
MERCER 23.7
OLIVER 20.5
BILLINGS 25.4
GOLDEN VALLEY 31.6
STARK 23.4
MORTON 18.2
BURLEIGH 17.7
KIDDER 17.2
STUTSMAN 24.1
BARNES 26.2
CASS 31.6
SLOPE 27.3
HETTINGER 28.9
GRANT 22.1
EMMONS 17.2
LOGAN 21.6
LA MOURE 24.1
RANSOM 25.4
RICHLAND 25.7
BOWMAN 22.7
ADAMS 21.0
SIOUX 14.8
McINTOSH 18.7
DICKEY 21.6
SARGENT 23.9

BARLEY PRODUCTION BY COUNTY

1974 - 1978 AVERAGE (THOUSAND BUSHELS)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RENVILLE 1080
BOTTINEAU 2640
ROLETTE 1788
TOWNER 3440
CAVALIER 7029
PEMBINA 4078
WILLIAMS 395
MOUNTRAIL 330
WARD 1253
McHENRY 774
PIERCE 1125
BENSON 2227
RAMSEY 3573
WALSH 5255
NELSON 2165
GRAND FORKS 6087
McKENZIE 391
McLEAN 504
SHERIDAN 399
WELLS 1706
EDDY 408
FOSTER 650
GRIGGS 1823
STEELE 3820
TRAILL 5206
DUNN 281
MERCER 124
OLIVER 195
BILLINGS 64
GOLDEN VALLEY 259
STARK 335
MORTON 586
BURLEIGH 419
KIDDER 281
STUTSMAN 1969
BARNES 4791
CASS 7086
SLOPE 222
HETTINGER 484
GRANT 257
EMMONS 238
LOGAN 137
LA MOURE 1088
RANSOM 1227
RICHLAND 2892
BOWMAN 342
ADAMS 198
SIOUX 75
McINTOSH 249
DICKEY 1595
SARGENT 1266

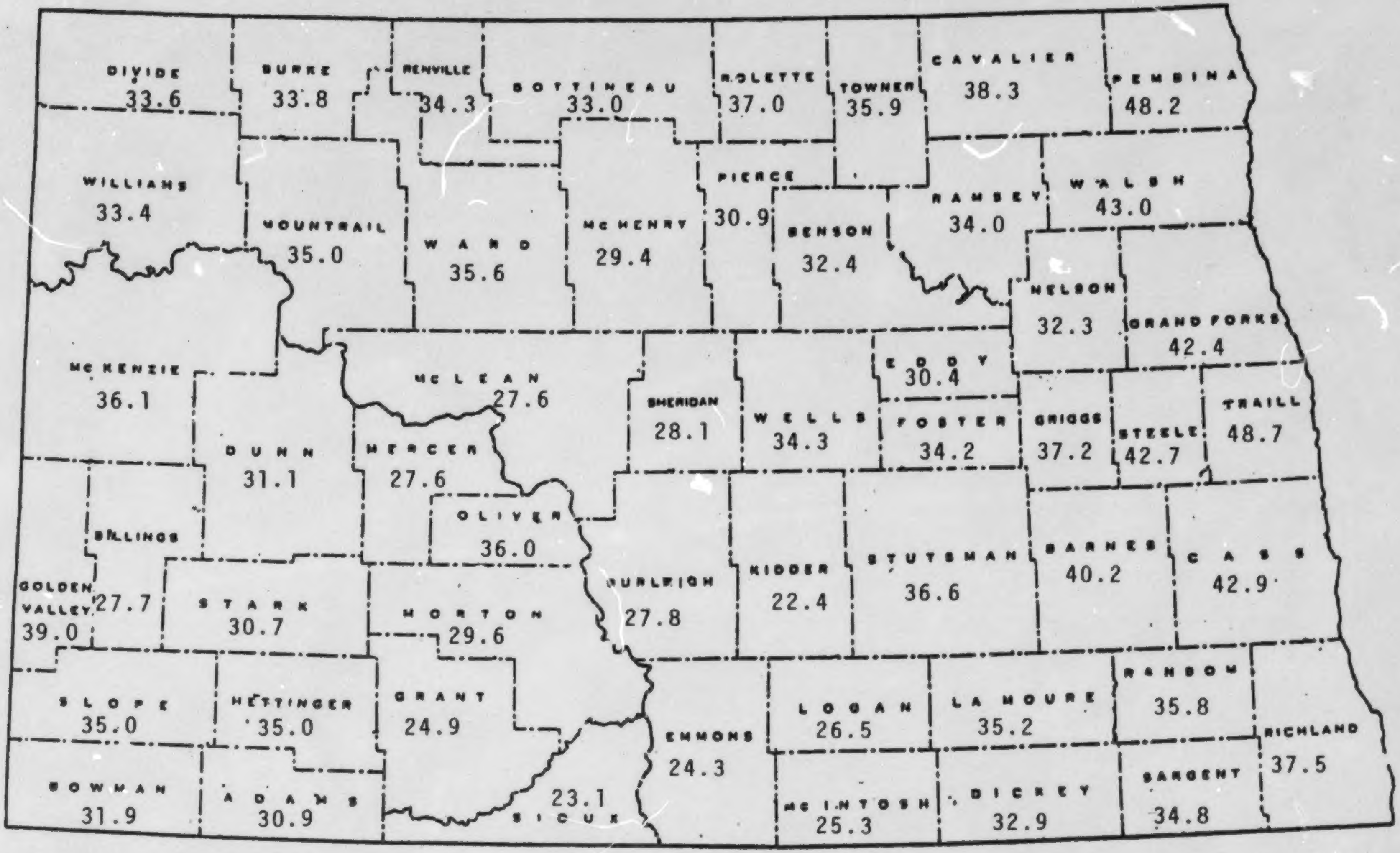
32

45

46

A-7-1
TM 18

BARLEY YIELD BY COUNTY
1974 - 1978 AVERAGE (BUSHELS)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RENVILLE 34.3
BOTTINEAU 33.0
ROLETTE 37.0
TOWNER 35.9
CAVALIER 38.3
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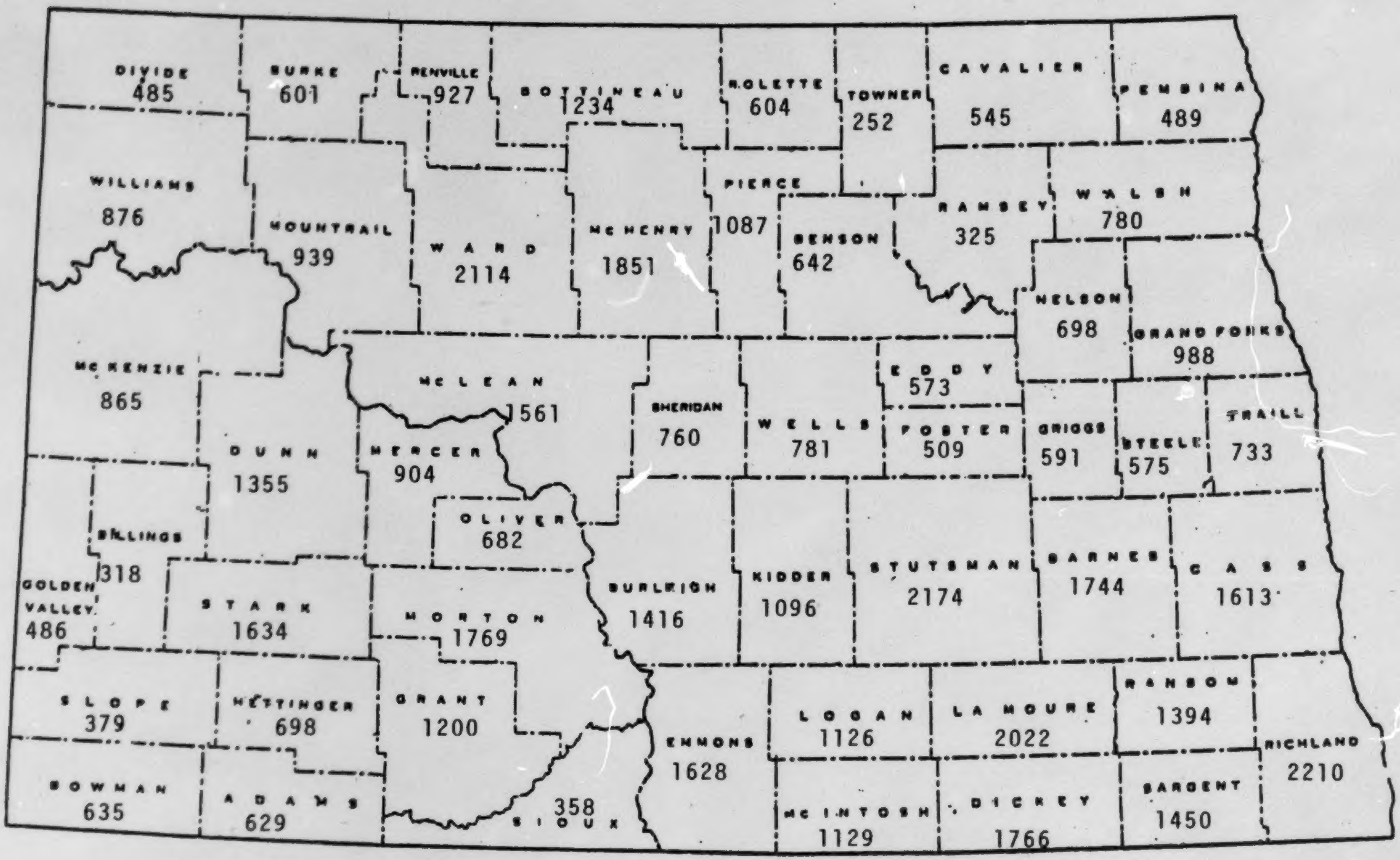
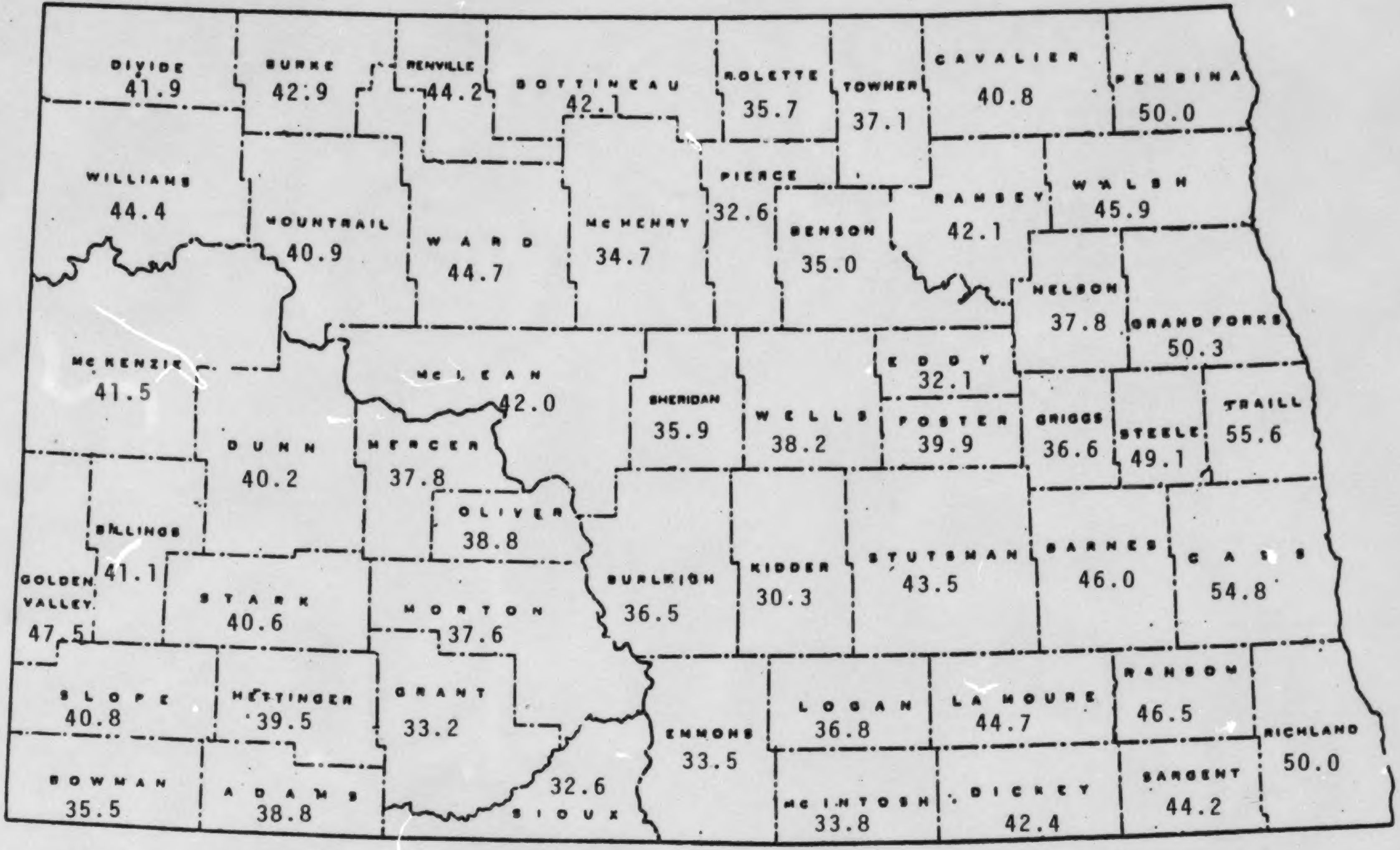
WILLIAMS 33.4
MOUNTRAIL 35.0
WARD 35.6
McHENRY 29.4
PIERCE 30.9
BENSON 32.4
RAMSEY 34.0
WALSH 43.0
NELSON 32.3
GRAND FORKS 42.4
McKENZIE 36.1
McLEAN 27.6
SHERIDAN 28.1
WELLS 34.3
EDDY 30.4
FOSTER 34.2
GRIGGS 37.2
STEELE 42.7
TRAILL 48.7
DUNN 31.1
MERCER 27.6
OLIVER 36.0
BILLINGS 27.7
GOLDEN VALLEY 39.0
STARK 30.7
MORTON 29.6
BURLEIGH 27.8
KIDDER 22.4
STUTSMAN 36.6
BARNES 40.2
CASS 42.9
SLOPE 35.0
HETTINGER 35.0
GRANT 24.9
EMMONS 24.3
LOGAN 26.5
LA MOURE 35.2
RANSOM 35.8
RICHLAND 37.5
BOWMAN 31.9
ADAMS 30.9
SIOUX 23.1
McINTOSH 25.3
DICKEY 32.9
SARGENT 34.8

OATS PRODUCTION BY COUNTY

1974 - 1978 AVERAGE (THOUSAND BUSHELS)

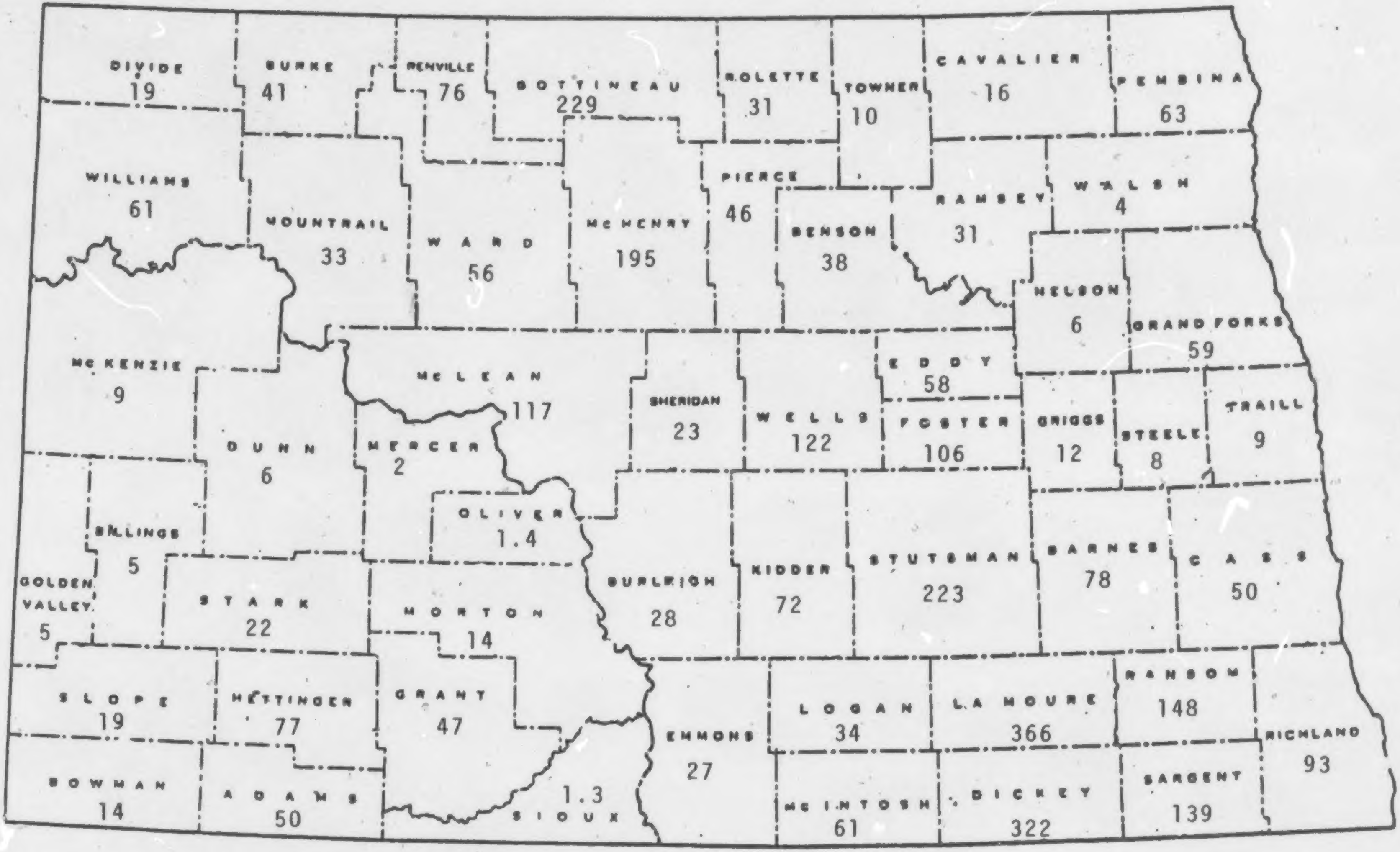

DIVIDE 485
BURKE 601
RENVILLE 927
BOTTINEAU 1234
ROLETTE 604
TOWNER 252
CAVALIER 545
PEMBINA 489
WILLIAMS 876
MOUNTRAIL 939
WARD 2114
MC HENRY 1851
PIERCE 1087
BENSON 642
RAMSEY 325
WALSH 780
NELSON 698
GRAND FORKS 988
MC KENZIE 865
MC LEAN 1561
SHERIDAN 760
WELLS 781
EDDY 573
FOSTER 509
GRIGGS 591
STEELE 575
TRAILL 733
DUNN 1355
MERCER 904
OLIVER 682
BILLINGS 318
GOLDEN VALLEY 486
STARK 1634
MORTON 1769
BURLEIGH 1416
KIDDER 1096
STUTSMAN 2174
BARNES 1744
CASS 1613
SLOPE 379
HETTINGER 698
GRANT 1200
EMMONS 1628
LOGAN 1126
LA MOURE 2022
RANSOM 1394
RICHLAND 2210
BOWMAN 635
ADAMS 629
SIOUX 358
MC INTOSH 1129
DICKEY 1766
SARGENT 1450

OATS YIELD [illegible]Y COUNTY
1974 - 1978 AVERAGE (BUSHELS)


DIVIDE 41.9
BURKE 42.9
RENVILLE 44.2
BOTTINEAU 42.1
ROLETTE 35.7
TOWNER 37.1
CAVALIER 40.8
PEMBINA 50.0
WILLIAMS 44.4
MOUNTRAIL 40.9
WARD 44.7
McHENRY 34.7
PIERCE 32.6
BENSON 35.0
RAMSEY 42.1
WALSH 45.9
NELSON 37.8
GRAND FORKS 50.3
McKENZIE 41.5
McLEAN 42.0
SHERIDAN 35.9
WELLS 38.2
EDDY 32.1
FOSTER 39.9
GRIGGS 36.6
STEELE 49.1
TRAILL 55.6
DUNN 40.2
MERCER 37.8
OLIVER 38.8
BILLINGS 41.1
GOLDEN VALLEY 47.5
STARK 40.6
MORTON 37.6
BURLEIGH 36.5
KIDDER 30.3
STUTSMAN 43.5
BARNES 46.0
CASS 54.8
SLOPE 40.8
HETTINGER 39.5
GRANT 33.2
EMMONS 33.5
LOGAN 36.8
LA MOURE 44.7
RANSOM 46.5
RICHLAND 50.0
BOWMAN 35.5
ADAMS 38.8
SIOUX 32.6
McINTOSH 33.8
DICKEY 42.4
SARGENT 44.2

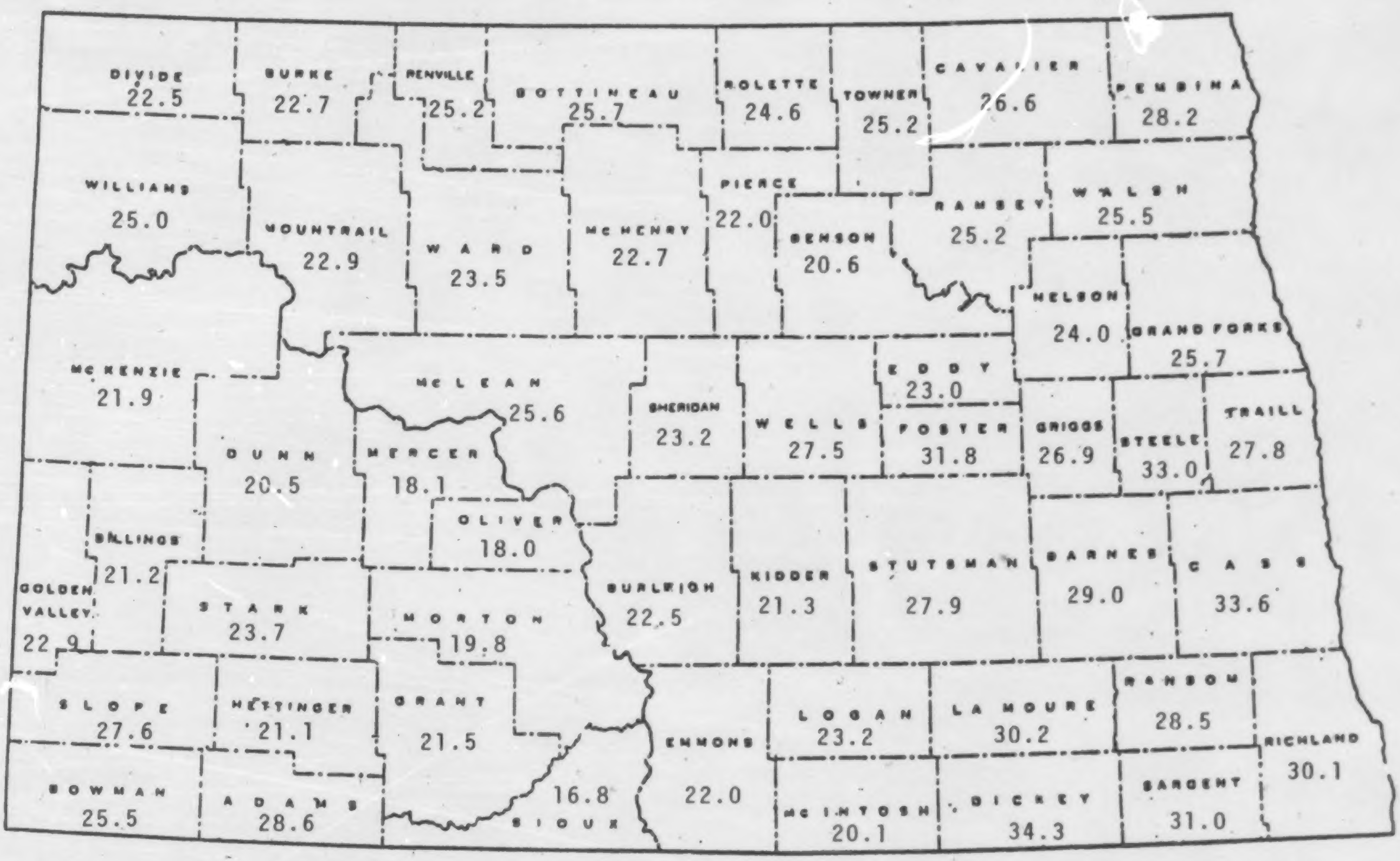
RYE PRODUC[illegible]N BY COUNTY

1974 - 1978 AVERAGE (THOUSAND BUSHELS)

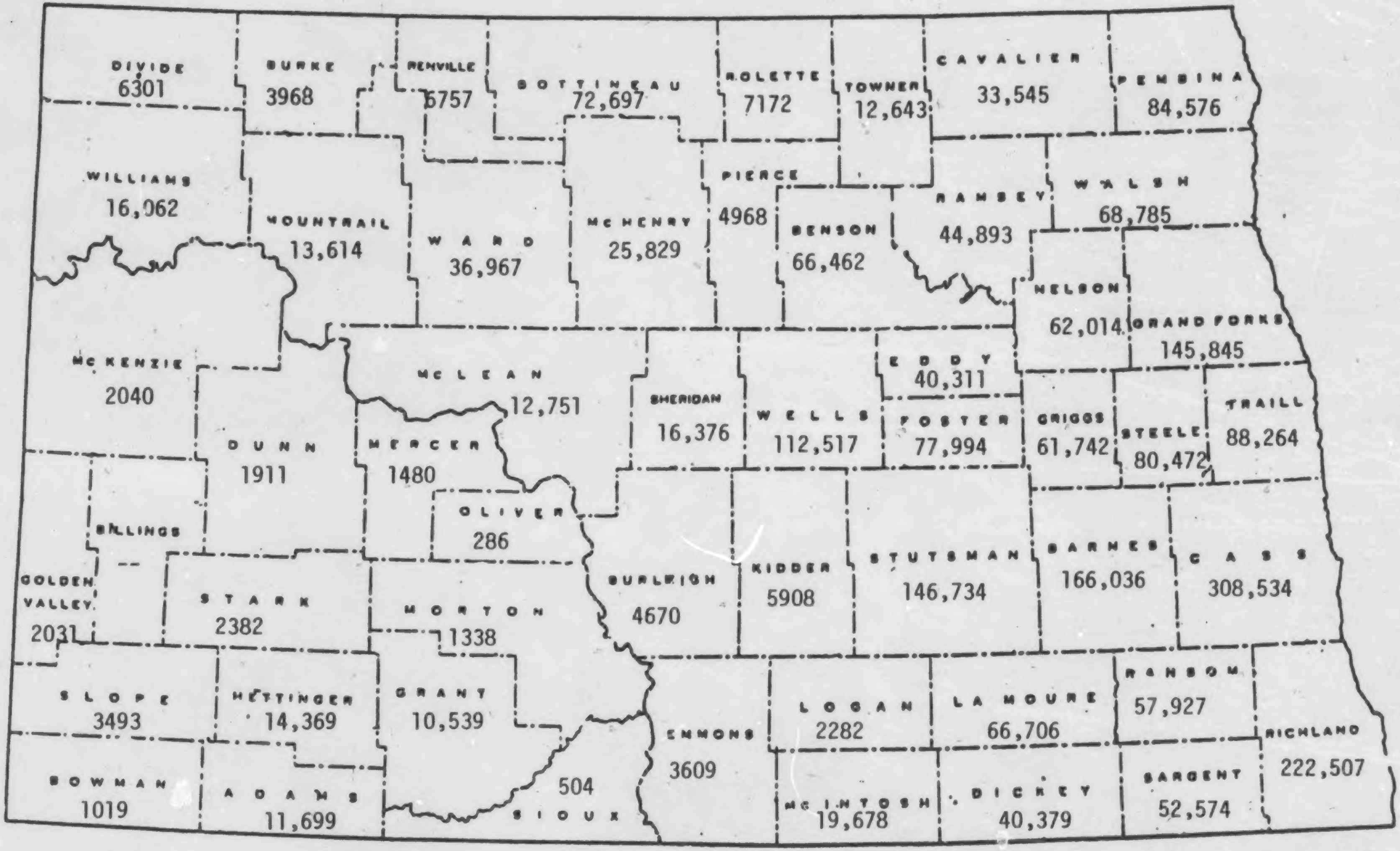

DIVIDE 19
BURKE 41
RENVILLE 76
BOTTINEAU 229
ROLETTE 31
TOWNER 10
CAVALIER 16
PEMBINA 63
WILLIAMS 61
MOUNTRAIL 33
WARD 56
McHENRY 195
PIERCE 46
BENSON 38
RAMSEY 31
WALSH 4
NELSON 6
GRAND FORKS 59
McKENZIE 9
McLEAN 117
SHERIDAN 23
WELLS 122
EDDY 58
FOSTER 106
GRIGGS 12
STEELE 8
TRAILL 9
DUNN 6
MERCER 2
OLIVER 1.4
BILLINGS 5
GOLDEN VALLEY 5
STARK 22
MORTON 14
BURLEIGH 28
KIDDER 72
STUTSMAN 223
BARNES 78
CASS 50
SLOPE 19
HETTINGER 77
GRANT 47
EMMONS 27
LOGAN 34
LA MOURE 366
RANSOM 148
RICHLAND 93
BOWMAN 14
ADAMS 50
SIOUX 1.3
McINTOSH 61
DICKEY 322
SARGENT 139

RYE YIELD [illegible] COUNTY

1974 - 1978 AVERAGE (BUSHELS)


DIVIDE 22.5
BURKE 22.7
RENVILLE 25.2
BOTTINEAU 25.7
ROLETTE 24.6
TOWNER 25.2
CAVALIER 26.6
PEMBINA 28.2
WILLIAMS 25.0
MOUNTRAIL 22.9
WARD 23.5
McHENRY 22.7
PIERCE 22.0
BENSON 20.6
RAMSEY 25.2
WALSH 25.5
NELSON 24.0
GRAND FORKS 25.7
McKENZIE 21.9
McLEAN 25.6
SHERIDAN 23.2
WELLS 27.5
EDDY 23.0
FOSTER 31.8
GRIGGS 26.9
STEELE 33.0
TRAILL 27.8
DUNN 20.5
MERCER 18.1
OLIVER 18.0
BILLINGS 21.2
GOLDEN VALLEY 22.9
STARK 23.7
MORTON 19.8
BURLEIGH 22.5
KIDDER 21.3
STUTSMAN 27.9
BARNES 29.0
CASS 33.6
SLOPE 27.6
HETTINGER 21.1
GRANT 21.5
EMMONS 22.0
LOGAN 23.2
LA MOURE 30.2
RANSOM 28.5
RICHLAND 30.1
BOWMAN 25.5
ADAMS 28.6
SIOUX 16.8
McINTOSH 20.1
DICKEY 34.3
SARGENT 31.0

OIL TYPE SUNFLOWER PRODUCTION BY COUNTY
1978 (THOUSAND POUNDS)


DIVIDE
6301
BURKE
3968
RENVILLE
5757
BOTTINEAU
72,697
ROLETTE
7172
TOWNER
12,643
CAVALIER
33,545
PEMBINA
84,576
WILLIAMS
16,062
MOUNTRAIL
13,614
WARD
36,967
McHENRY
25,829
PIERCE
4968
BENSON
66,462
RAMSEY
44,893
WALSH
68,785
NELSON
62,014
GRAND FORKS
145,845
McKENZIE
2040
McLEAN
12,751
SHERIDAN
16,376
WELLS
112,517
EDDY
40,311
FOSTER
77,994
GRIGGS
61,742
STEELE
80,472
TRAILL
88,264
DUNN
1911
MERCER
1480
OLIVER
286
BILLINGS
GOLDEN VALLEY
2031
STARK
2382
MORTON
1338
BURLEIGH
4670
KIDDER
5908
STUTSMAN
146,734
BARNES
166,036
CASS
308,534
SLOPE
3493
HETTINGER
14,369
GRANT
10,539
EMMONS
3609
LOGAN
2282
LA MOURE
66,706
RANSOM
57,927
RICHLAND
222,507
BOWMAN
1019
ADAMS
11,699
SIOUX
504
McINTOSH
19,678
DICKEY
40,379
SARGENT
52,574

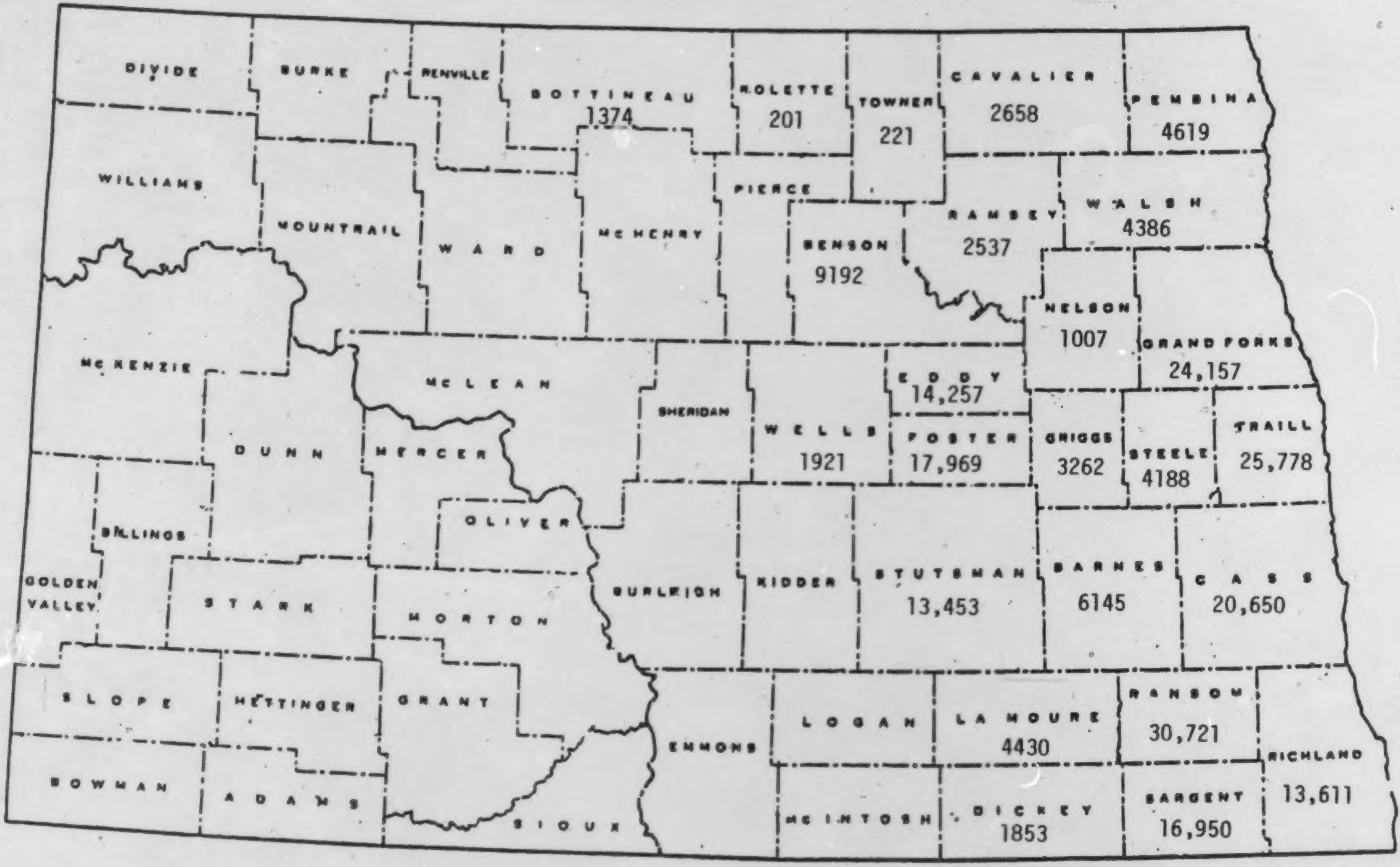
38

57

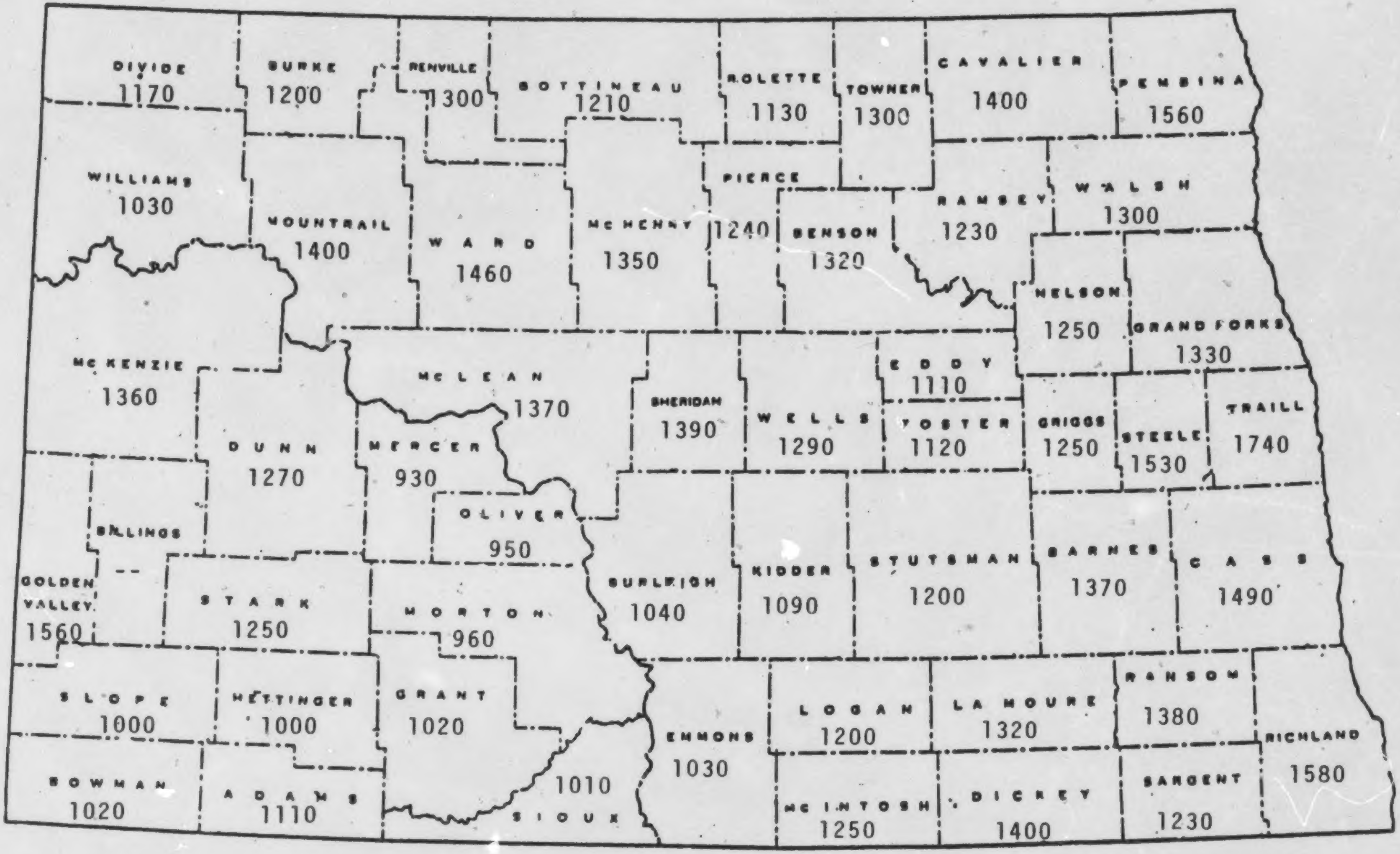
58

A-7-1
TM 24

NON-OIL TYPE SUNFLOWER PRODUCTION BY COUNTY
1978 (THOUSAND POUNDS)


DIVIDE
BURKE
RENVILLE
BOTTINEAU
1374
ROLETTE
201
TOWNER
221
CAVALIER
2658
PEMBINA
4619
WILLIAMS
MOUNTRAIL
WARD
McHENRY
PIERCE
BENSON
9192
RAMSEY
2537
WALSH
4386
NELSON
1007
GRAND FORKS
24,157
McKENZIE
McLEAN
SHERIDAN
WELLS
1921
EDDY
14,257
FOSTER
17,969
GRIGGS
3262
STEELE
4188
TRAILL
25,778
DUNN
MERCER
OLIVER
BILLINGS
GOLDEN VALLEY
STARK
MORTON
BURLEIGH
KIDDER
STUTSMAN
13,453
BARNES
6145
CASS
20,650
SLOPE
HETTINGER
GRANT
EMMONS
LOGAN
LA MOURE
4430
RANSOM
30,721
RICHLAND
13,611
BOWMAN
ADAMS
SIOUX
McINTOSH
DICKEY
1853
SARGENT
16,950

SUNFLOWER YIELD BY COUNTY
1978 (POUNDS)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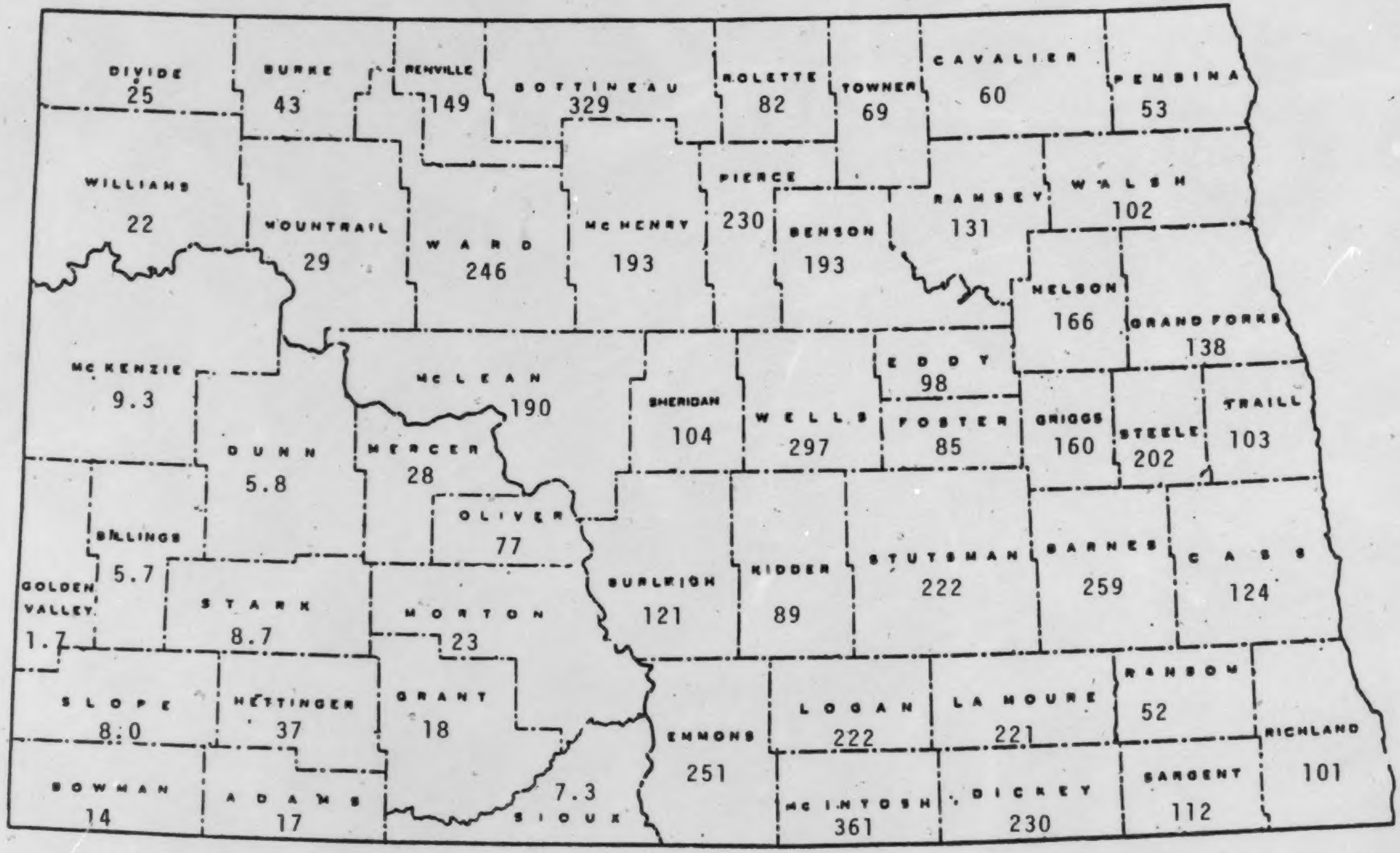
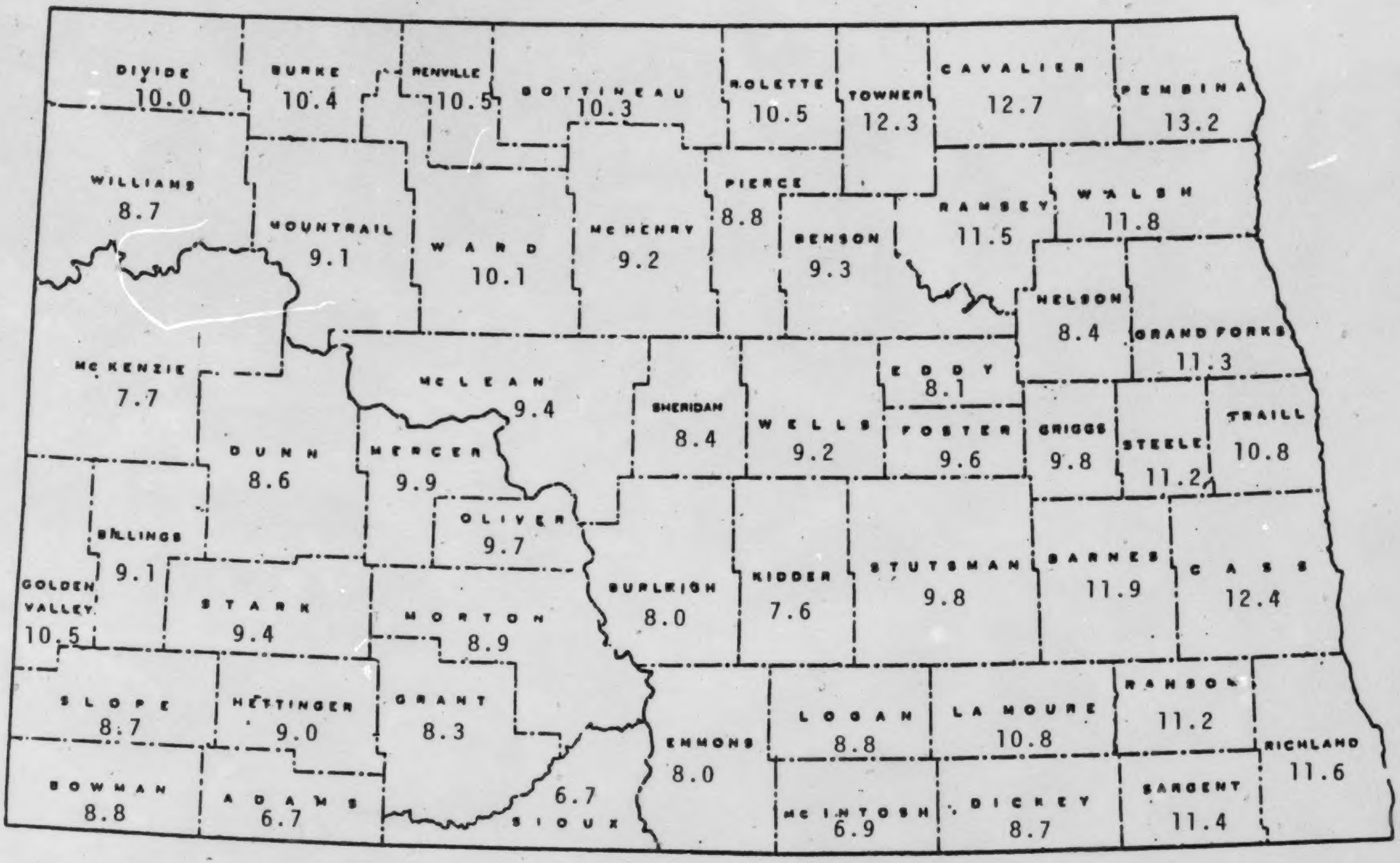
BURKE 1200
RENVILLE 1300
BOTTINEAU 1210
ROLETTE 1130
TOWNER 1300
CAVALIER 1400
PEMBINA 1560
WILLIAMS 1030
MOUNTRAIL 1400
WARD 1460
MC HENRY 1350
PIERCE 1240
BENSON 1320
RAMSEY 1230
WALSH 1300
NELSON 1250
GRAND FORKS 1330
MC KENZIE 1360
MC LEAN 1370
SHERIDAN 1390
WELLS 1290
EDDY 1110
FOSTER 1120
GRIGGS 1250
STEELE 1530
TRAILL 1740
DUNN 1270
MERCER 930
OLIVER 950
BILLINGS --
GOLDEN VALLEY 1560
STARK 1250
MORTON 960
BURLEIGH 1040
KIDDER 1090
STUTSMAN 1200
BARNES 1370
CASS 1490
SLOPE 1000
HETTINGER 1000
GRANT 1020
EMMONS 1030
LOGAN 1200
LA MOURE 1320
RANSOM 1380
RICHLAND 1580
BOWMAN 1020
ADAMS 1110
SIOUX 1010
MC INTOSH 1250
DICKEY 1400
SARGENT 1230

FLAXSEED PRODUCTION BY COUNTY
1974 - 1978 AVERAGE (THOUSAND BUSHELS)

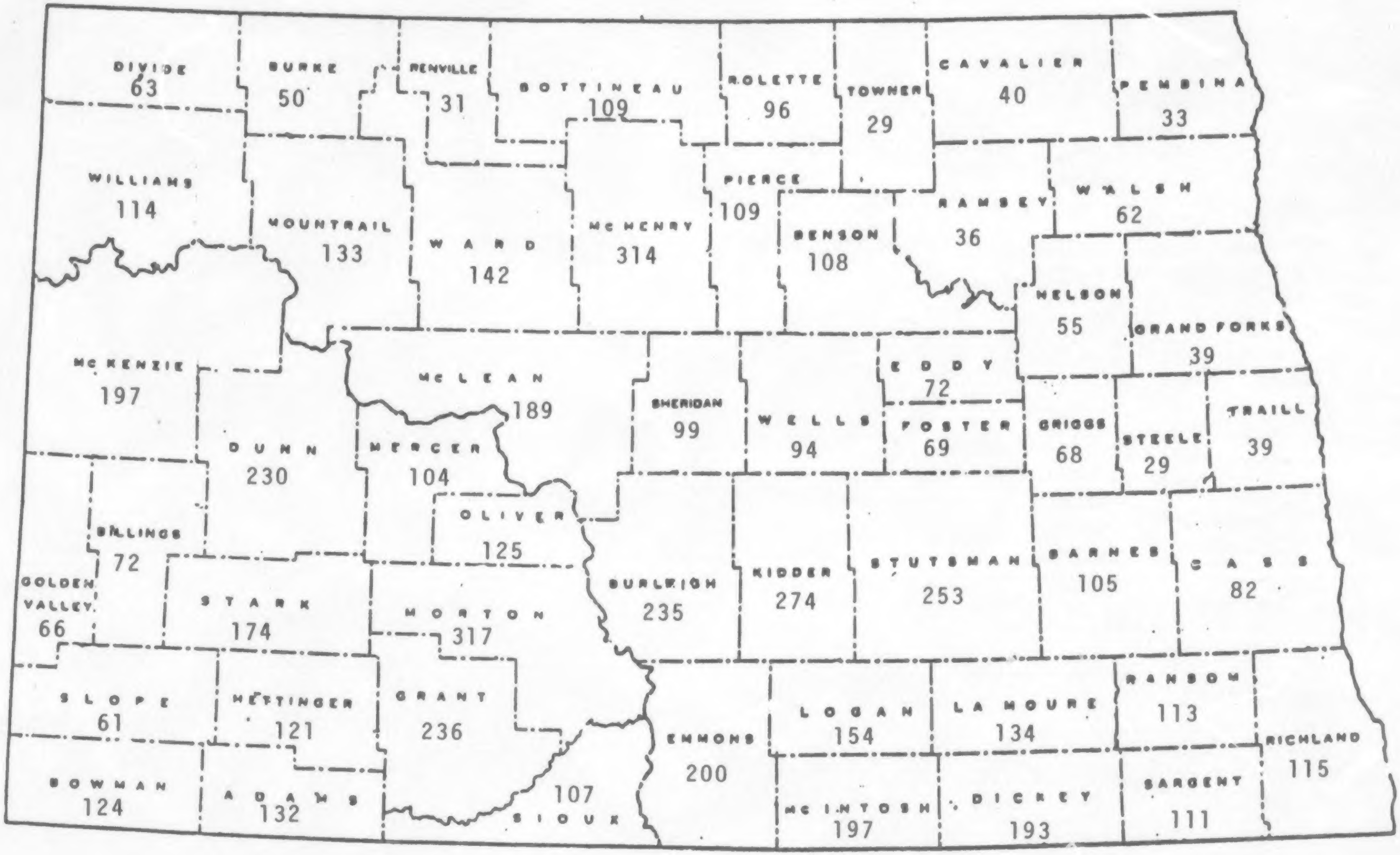

DIVIDE 25
BURKE 43
RENVILLE 149
BOTTINEAU 329
ROLETTE 82
TOWNER 69
CAVALIER 60
PEMBINA 53
WILLIAMS 22
MOUNTRAIL 29
WARD 246
McHENRY 193
PIERCE 230
BENSON 193
RAMSEY 131
WALSH 102
NELSON 166
GRAND FORKS 138
McKENZIE 9.3
McLEAN 190
SHERIDAN 104
WELLS 297
EDDY 98
FOSTER 85
GRIGGS 160
STEELE 202
TRAILL 103
DUNN 5.8
MERCER 28
OLIVER 77
BILLINGS 5.7
GOLDEN VALLEY 1.7
STARK 8.7
MORTON 23
BURLEIGH 121
KIDDER 89
STUTSMAN 222
BARNES 259
CASS 124
SLOPE 8.0
HETTINGER 37
GRANT 18
EMMONS 251
LOGAN 222
LA MOURE 221
RANSOM 52
RICHLAND 101
BOWMAN 14
ADAMS 17
SIOUX 7.3
McINTOSH 361
DICKEY 230
SARGENT 112

FLAXSEED YIELD BY COUNTY
1974 - 1978 AVERAGE (BUSHELS)

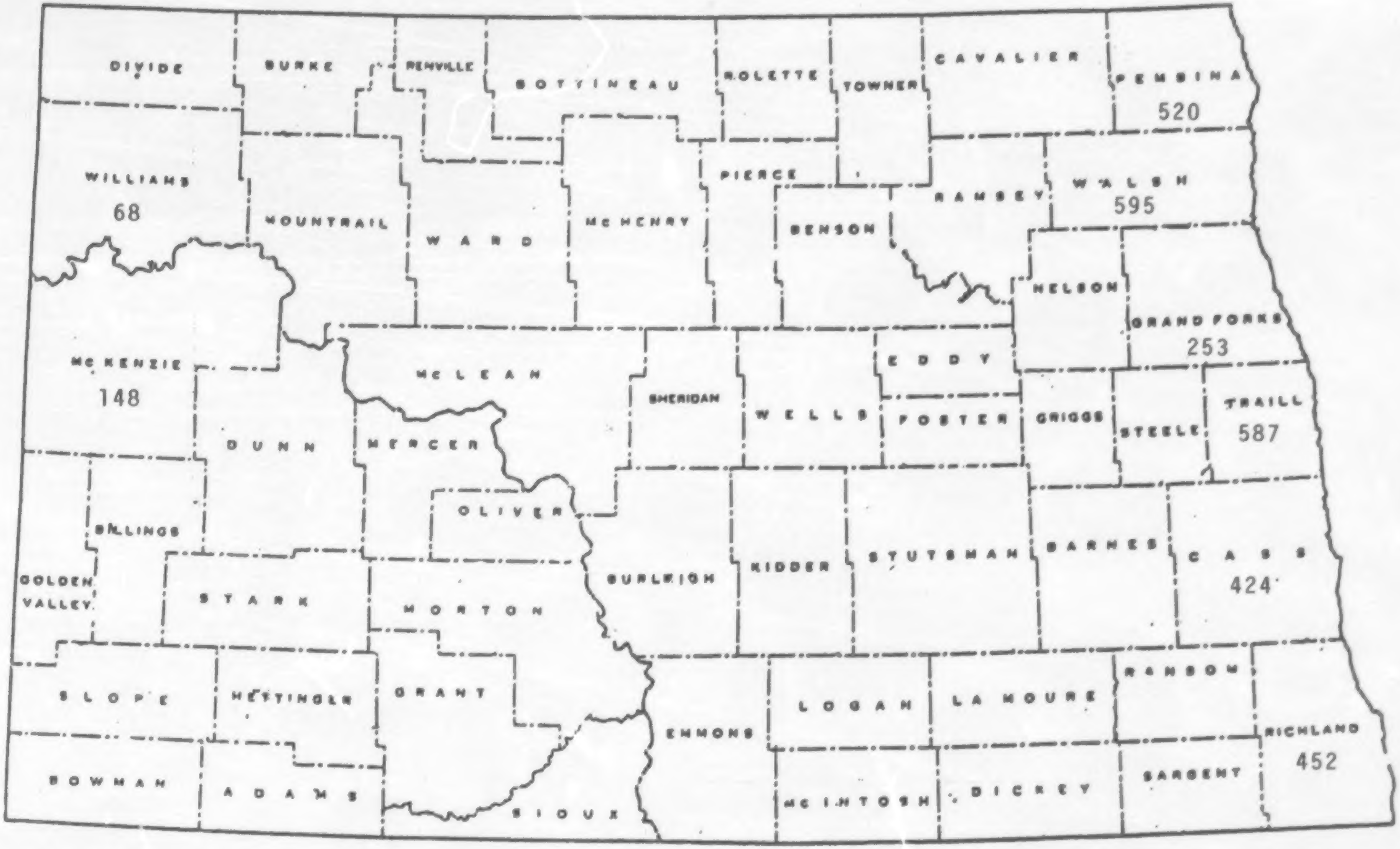

DIVIDE
10.0
BURKE
10.4
RENVILLE
10.5
BOTTINEAU
10.3
ROLETTE
10.5
TOWNER
12.3
CAVALIER
12.7
PEMBINA
13.2
WILLIAMS
8.7
MOUNTRAIL
9.1
WARD
10.1
McHENRY
9.2
PIERCE
8.8
BENSON
9.3
RAMSEY
11.5
WALSH
11.8
McKENZIE
7.7
McLEAN
9.4
SHERIDAN
8.4
WELLS
9.2
EDDY
8.1
NELSON
8.4
GRAND FORKS
11.3
DUNN
8.6
MERCER
9.9
FOSTER
9.6
GRIGGS
9.8
STEELE
11.2
TRAILL
10.8
BILLINGS
9.1
OLIVER
9.7
GOLDEN VALLEY
10.5
STARK
9.4
MORTON
8.9
BURLEIGH
8.0
KIDDER
7.6
STUTSMAN
9.8
BARNES
11.9
CASS
12.4
SLOPE
8.7
HETTINGER
9.0
GRANT
8.3
EMMONS
8.0
LOGAN
8.8
LA MOURE
10.8
RANSOM
11.2
RICHLAND
11.6
BOWMAN
8.8
ADAMS
6.7
SIOUX
6.7
McINTOSH
6.9
DICKEY
8.7
SARGENT
11.4

HAY PRODUCTION BY COUNTY

1978 (THOUSAND TONS)


DIVIDE 63
BURKE 50
RENVILLE 31
BOTTINEAU 109
ROLETTE 96
TOWNER 29
CAVALIER 40
PEMBINA 33
WILLIAMS 114
MOUNTRAIL 133
WARD 142
MC HENRY 314
PIERCE 109
BENSON 108
RAMSEY 36
WALSH 62
NELSON 55
GRAND FORKS 39
MC KENZIE 197
MC LEAN 189
SHERIDAN 99
WELLS 94
EDDY 72
FOSTER 69
GRIGGS 68
STEELE 29
TRAILL 39
DUNN 230
MERCER 104
OLIVER 125
BILLINGS 72
GOLDEN VALLEY 66
STARK 174
MORTON 317
BURLEIGH 235
KIDDER 274
STUTSMAN 253
BARNES 105
CASS 82
SLOPE 61
HETTINGER 121
GRANT 236
EMMONS 200
LOGAN 154
LA MOURE 134
RANSOM 113
RICHLAND 115
BOWMAN 124
ADAMS 132
SIOUX 107
MC INTOSH 197
DICKEY 193
SARGENT 111

SUGARBEET PRODUCTION BY COUNTY
1978 (THOUSAND TONS)


DIVIDE
BURKE
RENVILLE
BOTTINEAU
ROLETTE
TOWNER
CAVALIER
PEMBINA
520
WILLIAMS
68
MOUNTRAIL
WARD
McHENRY
PIERCE
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RAMSEY
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595
NELSON
GRAND FORKS
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McLEAN
SHERIDAN
WELLS
EDDY
FOSTER
GRIGGS
STEELE
TRAILL
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KIDDER
STUTSMAN
BARNES
CASS
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SLOPE
HETTINGER
GRANT
EMMONS
LOGAN
LA MOURE
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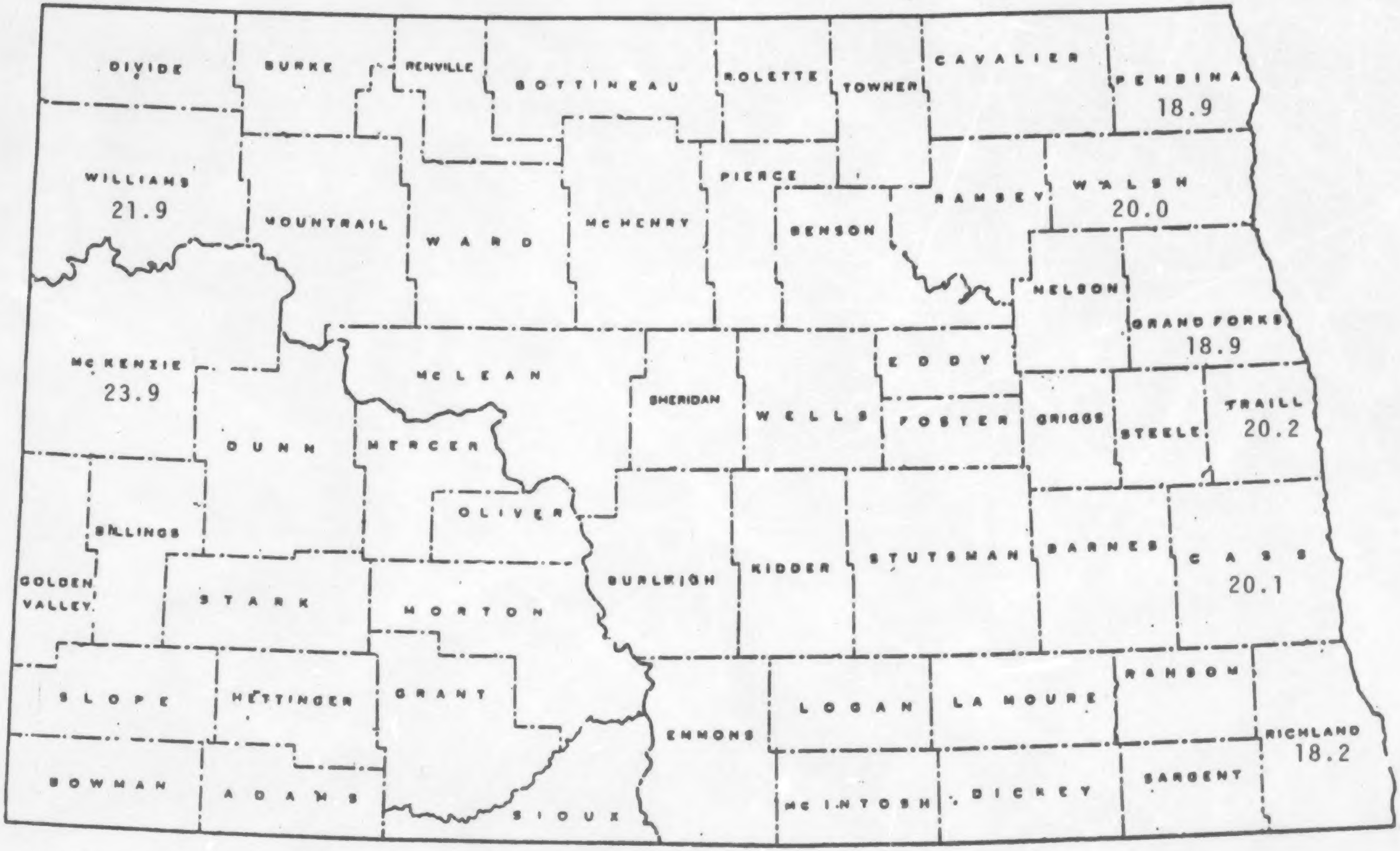
DICKEY
SARGENT

SUGARBEET YIELD BY COUNTY
1978 (TONS)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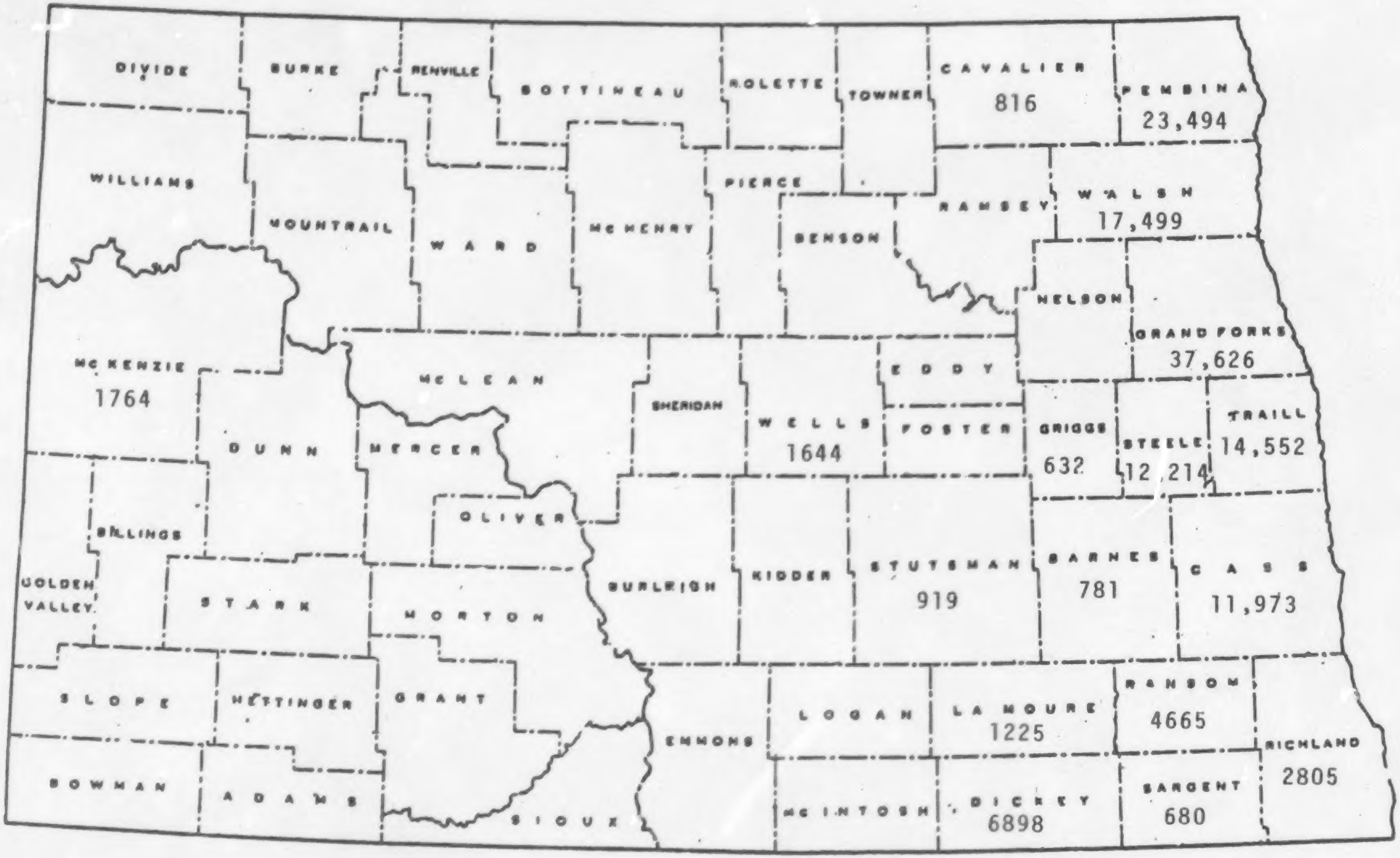
71

72

DRY EDIBLE BEAN PRODUCTION BY COUNTY
1979 PRELIMINARY (THOUSAND POUNDS)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SHERIDAN
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FOSTER
GRIGGS
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SARGENT
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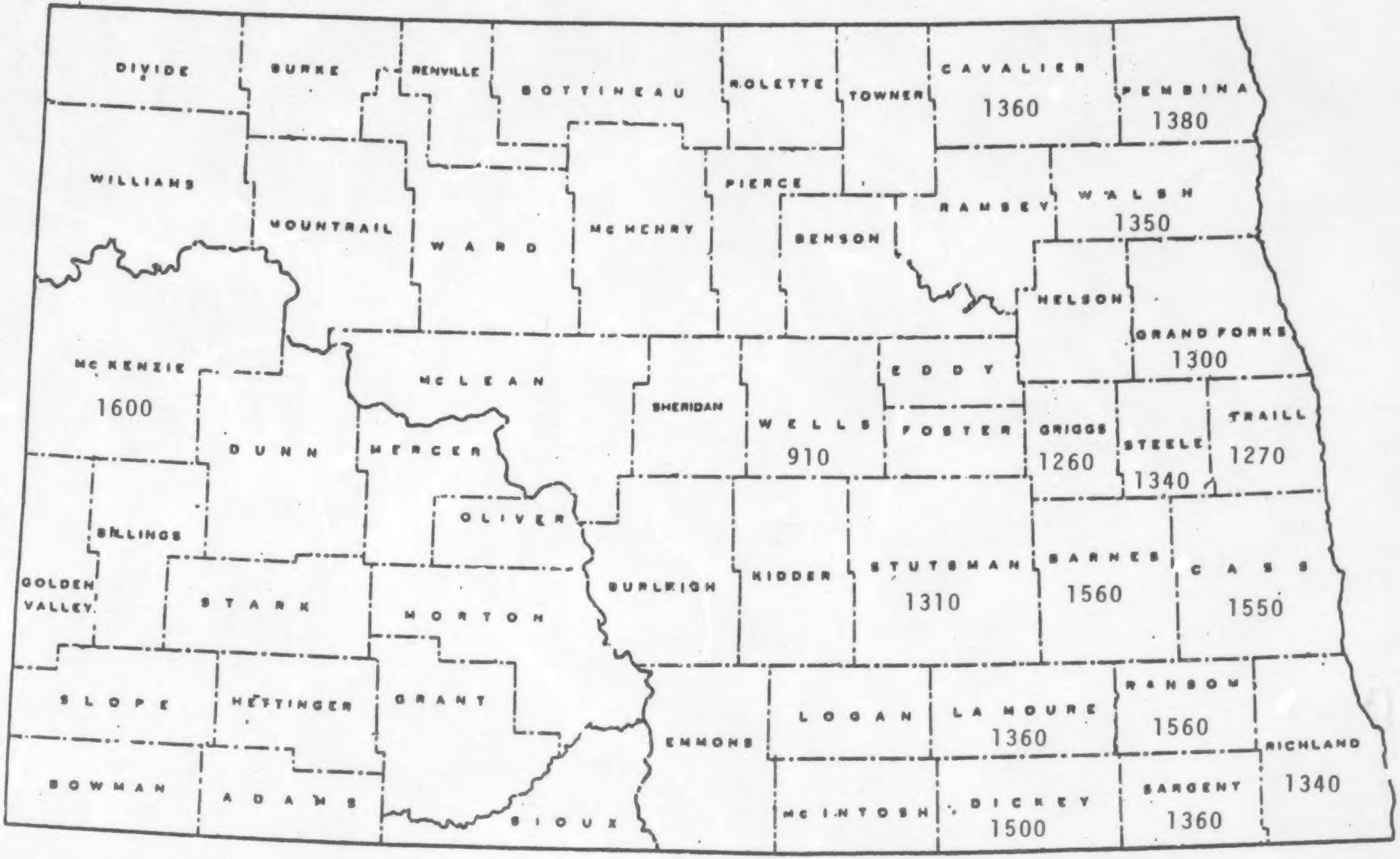
DRY EDIBLE BEAN YIELD BY COUNTY
1979 PRELIMINARY (POUNDS)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RANSOM
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RICHLAND
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McINTOSH
DICKEY
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SARGENT
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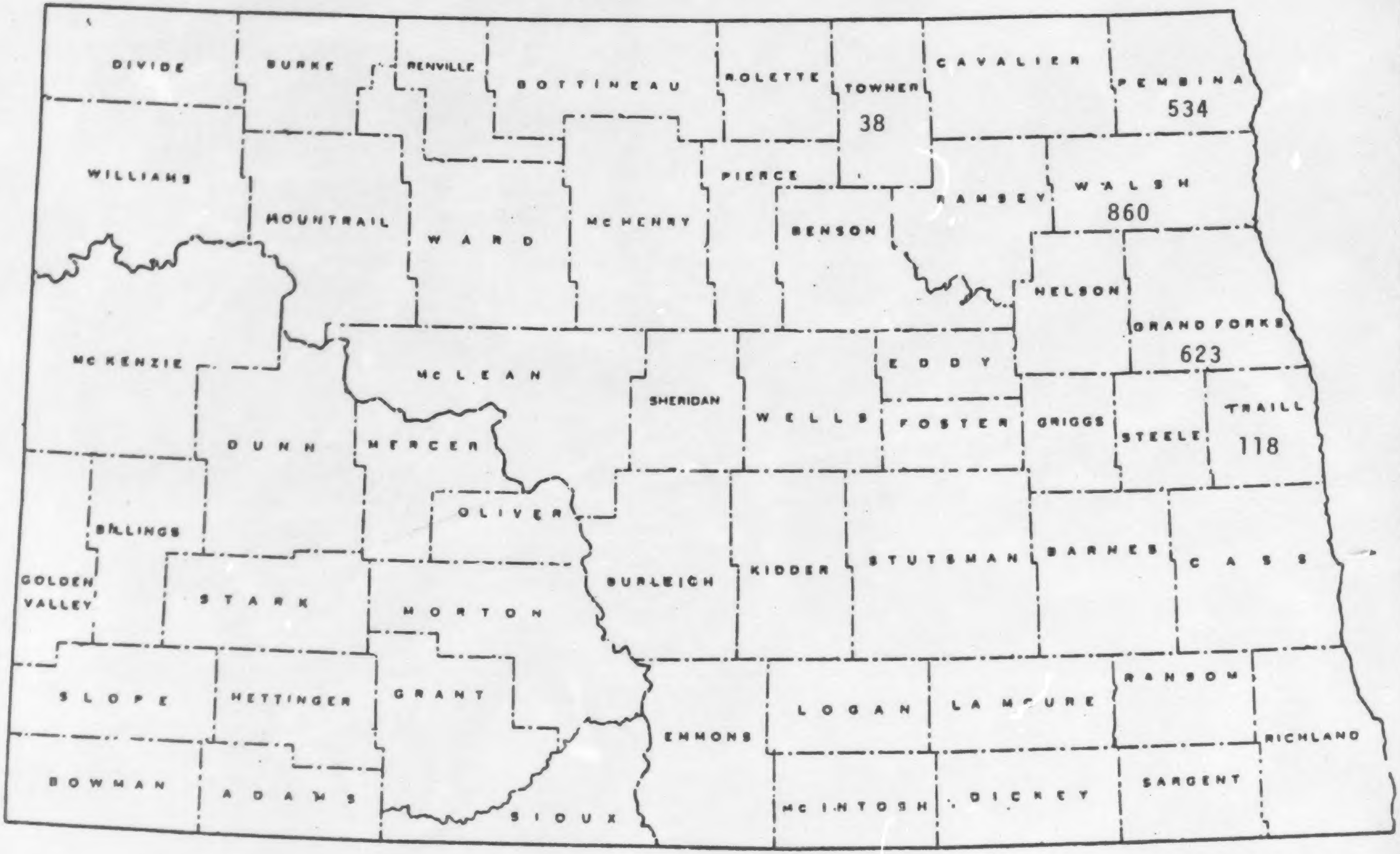
POTATO PRODUCTION BY COUNTY
1978 (MILLION POUNDS)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WARD
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PIERCE
BENSON
RAMSEY
WALSH
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NELSON
GRAND FORKS
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McKENZIE
McLEAN
SHERIDAN
WELLS
EDDY
FOSTER
GRIGGS
STEELE
TRAILL
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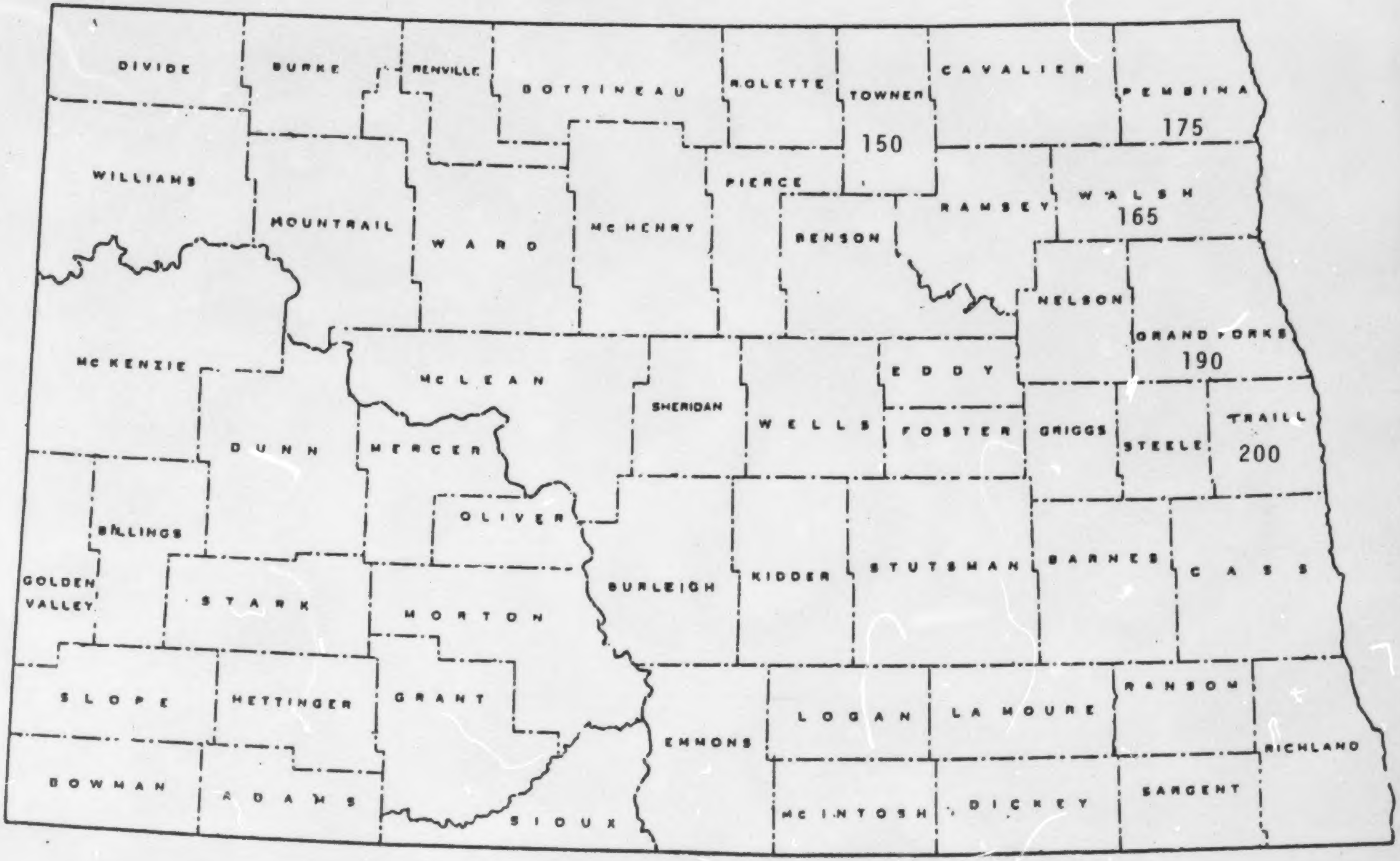
DUNN
MERCER
OLIVER
BILLINGS
GOLDEN VALLEY
STARK
MORTON
BURLEIGH
KIDDER
STUTSMAN
BARNES
CASS
SLOPE
HETTINGER
GRANT
EMMONS
LOGAN
LA MOURE
RANSOM
RICHLAND
BOWMAN
ADAMS
SIOUX
McINTOSH
DICKEY
SARGENT

POTATO YIELD BY COUNTY
1978 (CWT.)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PIERCE
BENSON
RAMSEY
WALSH
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GRAND FORKS
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McKENZIE
McLEAN
SHERIDAN
WELLS
EDDY
FOSTER
GRIGGS
STEELE
TRAILL
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MERCER
OLIVER
BILLINGS
GOLDEN VALLEY
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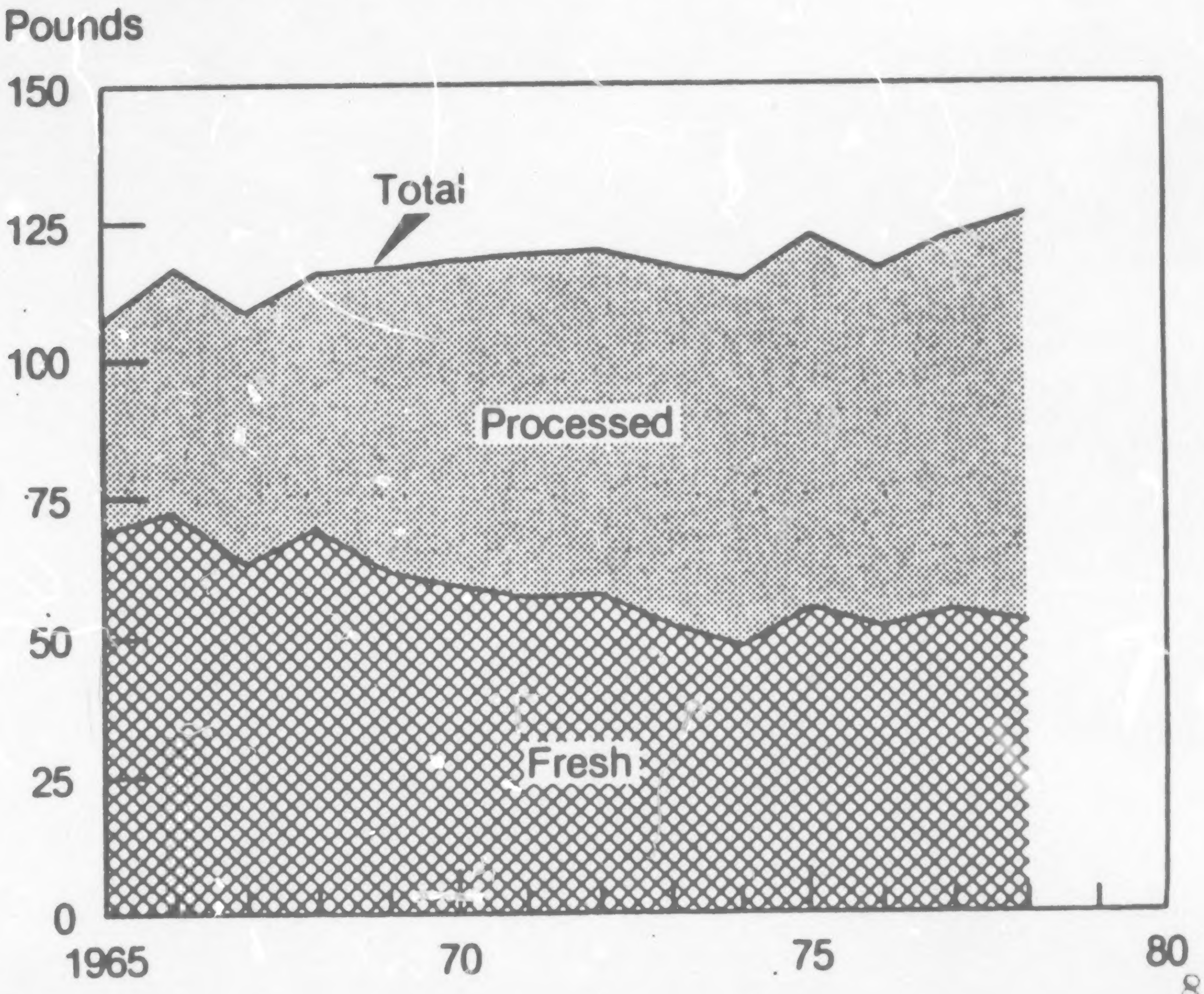
DICKEY
SARGENT

Potato Consumption per Capita



Source: 1979 Handbook of Agricultural Charts. United States Department of Agriculture.

Job 2: Identifying Plant Parts.

Objectives:

The objectives of this job shall be met at a level predetermined by the instructor. The manner in which they are to be evaluated shall also be determined by the instructor.

Upon completion of this job, the students shall be able:

1. to list the two major subclasses of plants, and give examples of each.
2. to identify parts of a seed and differentiate between grass and dicot seeds.
3. to identify tap and fibrous root systems.
4. to identify differentiating stem characteristics.
5. to identify differentiating leaf characteristics.
6. to differentiate between grass and dicot flowers.

Guide Questions:

1. What are the major subclasses of plants?
2. What are the identifying characteristics of seeds?
3. What are the identifying characteristics of roots?
4. What are the identifying characteristics of stems?
5. What are the identifying characteristics of leaves?
6. What are the identifying characteristics of flowers?

References:

Delorit, Richard J., Louis J. Greub, and Henry L. Ahlgren. Crop Production. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1974.

Messersmith, Calvin and Edward Deckard. Agronomy 103 Laboratory Guide. Agronomy Department, North Dakota State University, 1976.

Messersmith, Calvin and Edward Deckard. Agronomy 103 Lecture Guide. Agronomy Department, North Dakota State University, 1978.

Miller, Duane G., Gilbert A. Long, and Clarence K. Manning. Transparency Masters for Crop and Weed Identification. Washington State University, Pullman, Washington, 1968.

Interest Approach:

Ask the students if they have ever seen a peanut plant when the peanuts are ripe and ready to be picked from the branches. Describe the process until someone in the class points out that peanuts grow underground. Point out the importance of knowing plant parts, their location and function.

Key Facts:

I. Major Plant Subclasses.

  A. Monocot.

    1. Grasses are the major family.

    2. Characterized by narrow leaf.

    3. Examples.

      a. Small grains.
      b. Grass hays.
      c. Corn.

  B. Dicots.

    1. Many different families.

    2. Leaf is usually shorter and wider.

    3. Examples.

      a. Soybeans.
      b. Sunflowers.
      c. Alfalfa.
      d. Trees and shrubs.

II. Seeds.

  A. Identifying characteristics.

    1. Size.

    2. Shape.

    3. Color.

    4. Seed coat.

    5. Special characteristics.

  B. Structure.

    1. Grasses. (Transparency 1)

- a. Seed coat.
    - 1) Two layers united together.
    - 2) Protects inner parts.
    - 3) By-product when milled called bran.
- b. Endosperm.
    - 1) Food storage for new plant.
    - 2) Part that is used for flour or malt.
    - 3) Largest portion of the seed.
- c. Embryo.
    - 1) Part that develops into new plant.
    - 2) By-product when milled called germ.
    - 3) Parts.
        - a) Cotyledon.
            - i) Seed leaf.
            - ii) Only one in grasses - monocot.
        - b) Radicle - seed root.

2. Dicots. (Transparency 2)

- a. Seed coat.
    - 1) May be inside a pod.
    - 2) Pod is outside layer with inside layer covering each seed.
- b. Embryo.
    - 1) Most dicots have no endosperm and store food in the embryo.
    - 2) Parts.
        - a) Cotyledons.
            - i) Two found in dicots.
            - ii) Food storage.
            - iii) Major portion of seed.
            - iv) Easily seen as half of a bean or pea seed.
        - b) Epicotyl.
            - i) Attached above the cotyledons.
            - ii) Become the first true leaves of the plant.
        - c) Radicle - seed root.

3. Comparing grass and dicot seeds. (Transparency 3)

    a. Food storage.

        1) Monocot - endosperm.
        2) Dicot - cotyledons.

    b. Cotyledons.

        1) Monocot - one small cotyledon.
        2) Dicot - two large cotyledons.

III. Root Characteristics. (Transparency 4)

A. Tap root system.

1. One main root, larger than others.

2. Various number of secondary roots branching out.

3. Carrots and sugarbeets are examples of large tap roots used for food.

B. Fibrous root system.

1. Several major roots all equal in size.

2. Numerous secondary roots.

3. Found on most small grains.

C. Perennial root system.

1. Perennials are plants which live for 3 or more years.

2. Root system is important in renewing growth each spring.

3. May start out with either a tap root or fibrous root.

4. Various changes develop, adapted for continued growth.

    a. Fibrous.

        1) Produce a bulb which develops into a new plant each year.
        2) Underground stem called a rhizome sends up stem to become a new plant.

    b. Tap root.

        1) Buds develop near top of root and produce a new stem.
        2) Develop a long root branch which sends up stem to become a new plant.

IV. Stem Characteristics.

- A. Stem types.
  - 1. Erect.
    - a. Projects up from the ground.
    - b. Supports leaves and flower parts.
    - c. Most common type.
  - 2. Climbing.
    - a. Does not have supportive tissue for erect growth.
    - b. Stem grows along the ground, other plants, fences or other structures.
  - 3. Rosette.
    - a. Stem does not grow.
    - b. Leaves all grow from the same point.
    - c. Sugarbeet is an example.
- B. Leaf arrangement. (Transparency 5)
  - 1. Alternate.
    - a. Only one leaf or branch at each joint in the stem or node.
    - b. Leaves normally alternate sides but not always.
  - 2. Opposite.
    - a. Two leaves or branches at each node.
    - b. Usually exactly opposite each other.
  - 3. Whorled.
    - a. Three or more leaves or branches at each node.
    - b. Pointed in various directions.
- C. Stem appearance.
  - 1. May be rough or smooth.
  - 2. Some have thorns.

V. Leaf Characteristics.

- A. Numerous different leaf shapes. (Transparency 6)
- B. Leaf margin refers to the outside edge of the leaf. (Transparency 7)
- C. The leaf tip differs by how rounded or pointed it is. (Transparency 8)

D. Leaf attachment. (Transparency 9)

1. Petiolate - leaf stalk extends the leaf away from the stem.

2. Sessile - leaf blade attaches directly to the stem.

3. Clasping - leaf blade attaches directly to the stem and wraps around it.

4. Compound leaves - the leaf blade consists of several leaflets.

   a. Palmate - leaflets all attached at one point.
   b. Pinnate - several leaflets extending down the leaf stalk.

E. Leaf venation. (Transparency 10)

1. Parallel.

   a. Veins are side by side and do not branch or intersect.
   b. Characteristic of grasses.

2. Net.

   a. Veins intersect and branch from one another.
   b. Characteristic of dicots.

F. Auricles. (Transparency 11)

1. Found only on grasses.

2. Two ear-like projections at base of the leaf blade, opposite side.

3. Differ between crops in size, shape, and presence of hairs.

VI. Flower Characteristics.

A. Wide variety of flower types.

B. Primary basis for plant classifications.

C. Important as location of seed production.

D. Dicot flower. (Transparency 12)

1. Pistil.

   a. Female part of flower.
   b. Contains egg cell.
   c. Usually located in center of flower.

2. Stamen.

    a. Male part of flower.
    b. Produces pollen.
    c. Usually several located around the pistil.

3. Petals.

    a. Most noticeable feature.
    b. Often brightly colored.
    c. Located in whorl around the stamens.

4. Sepals.

    a. Green leaf-like structure.
    b. Located in a whorl around the petals.

5. Associated parts.

    a. Recepticle - base of the flower.
    b. Pedicel - stem which supports one flower.

E. Grass flower. (Transparency 13)

1. Two types.

    a. Spike - flower attaches directly to stem.
    b. Panicle - flower is suspended out from the stem.

2. Pistil and stamen are similar to dicot but shaped differently.

3. Bracts.

    a. Leaf-like structures.
    b. Different kinds and shapes.
    c. Located around pistil and stamens with some types covering them.

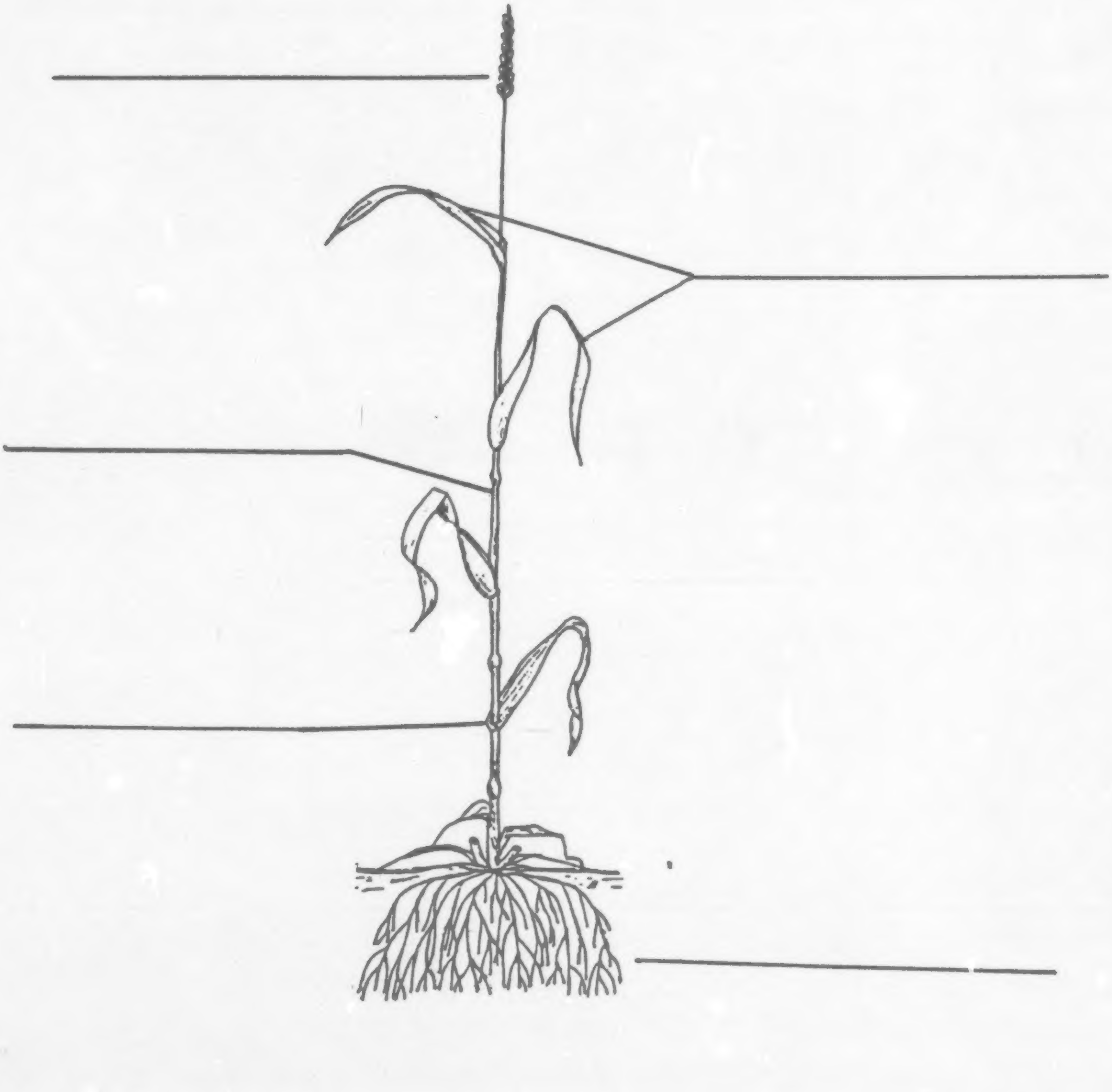
Student Learning Activities:

1. Have the students inspect various kinds of seeds and plants to determine plant parts and whether dicot or grass.

2. Have the students complete worksheets #1 and #2.

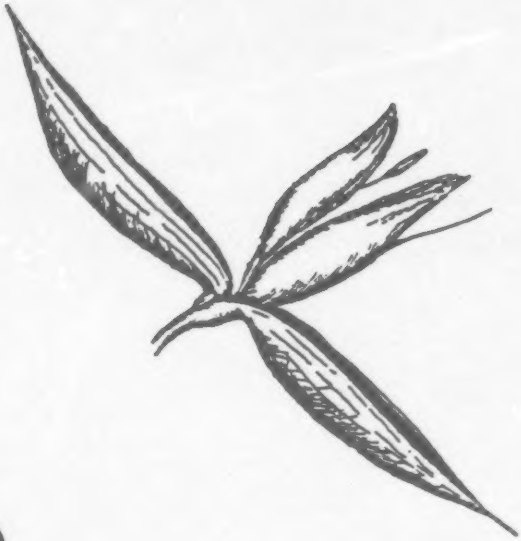
Worksheet #1

Label the auricle, flower, leaves, root, and stem on this grass plant.



Worksheet #2

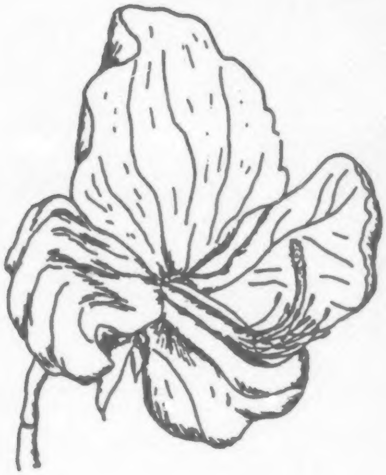
Draw lines to match the correct plant part types.

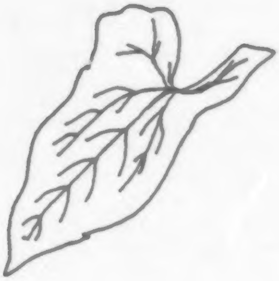


FLOWERS

DICOT

GRASS

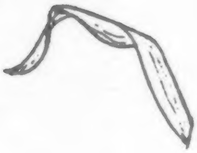


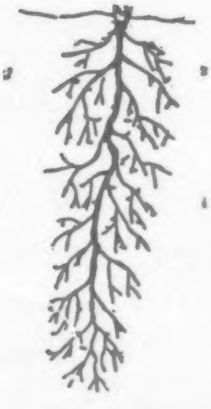


LEAVES

PARALLEL

NET

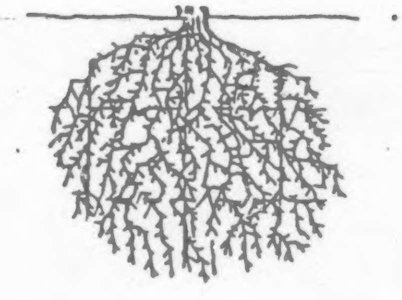




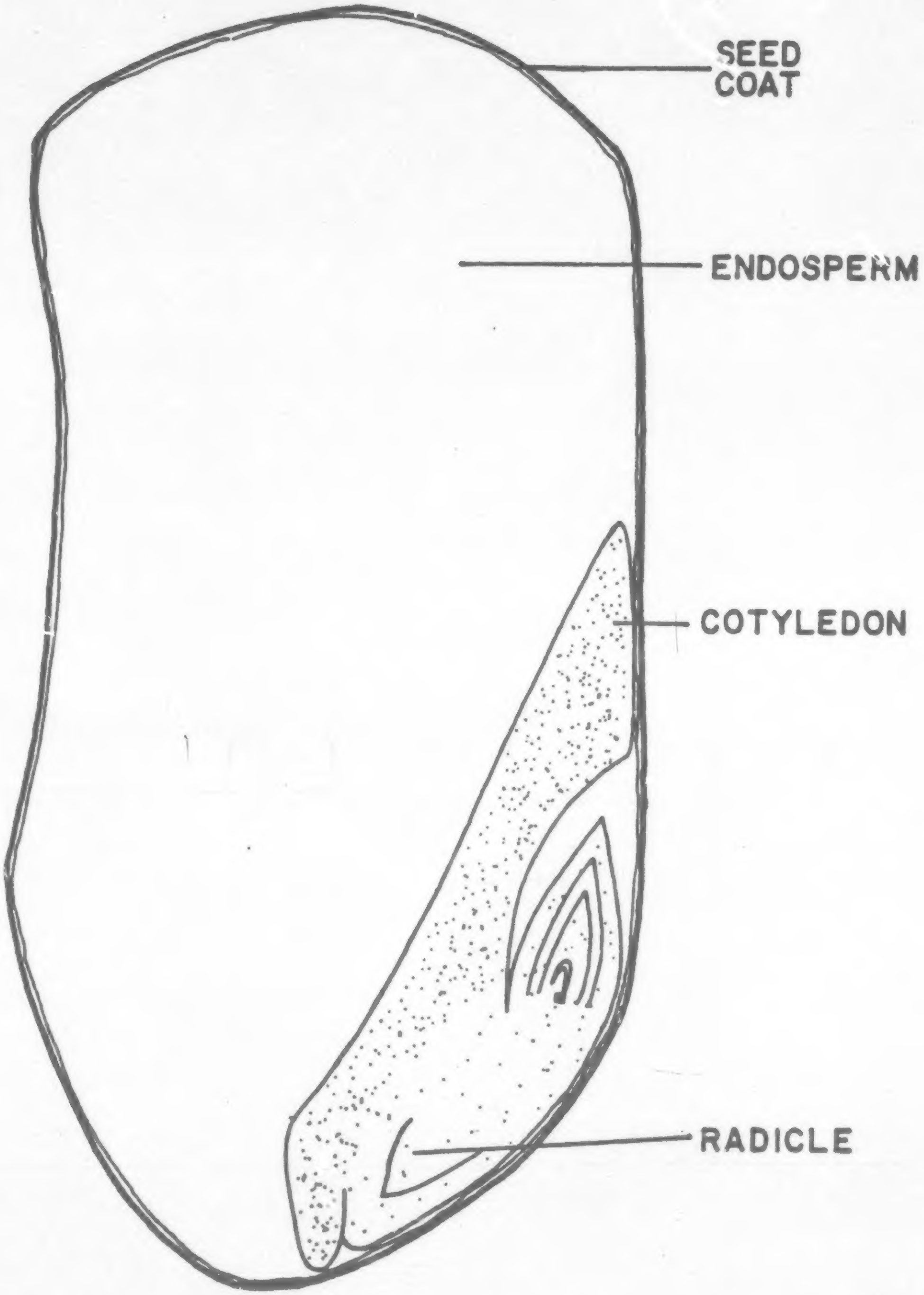
ROOTS

FIBROUS

TAP

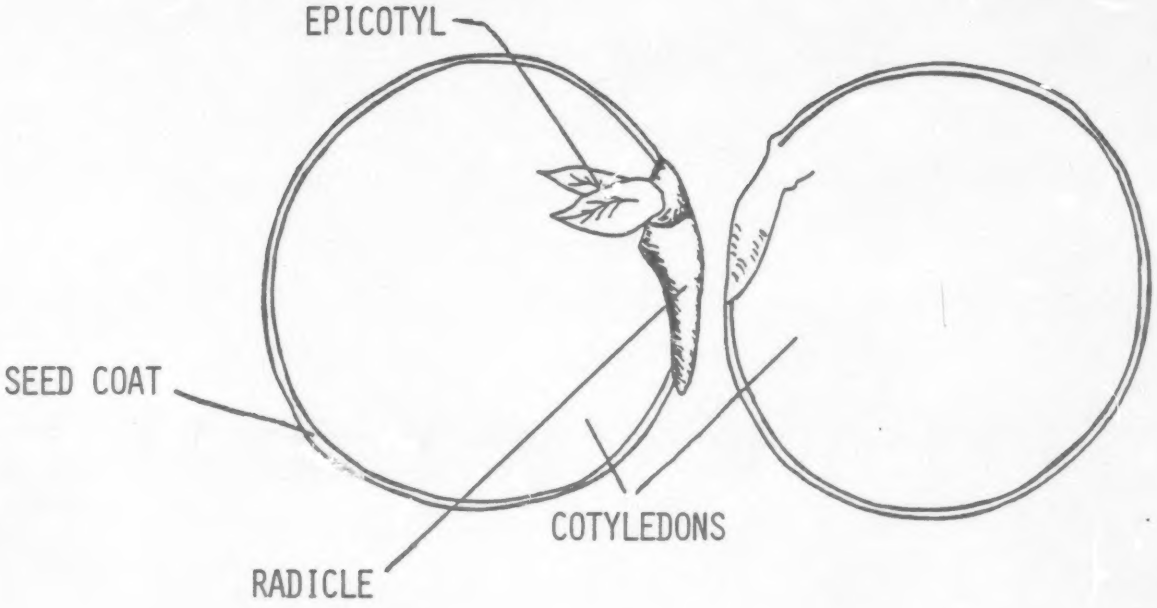


MONOCOT SEED


SEED COAT
ENDOSPERM
COTYLEDON
RADICLE

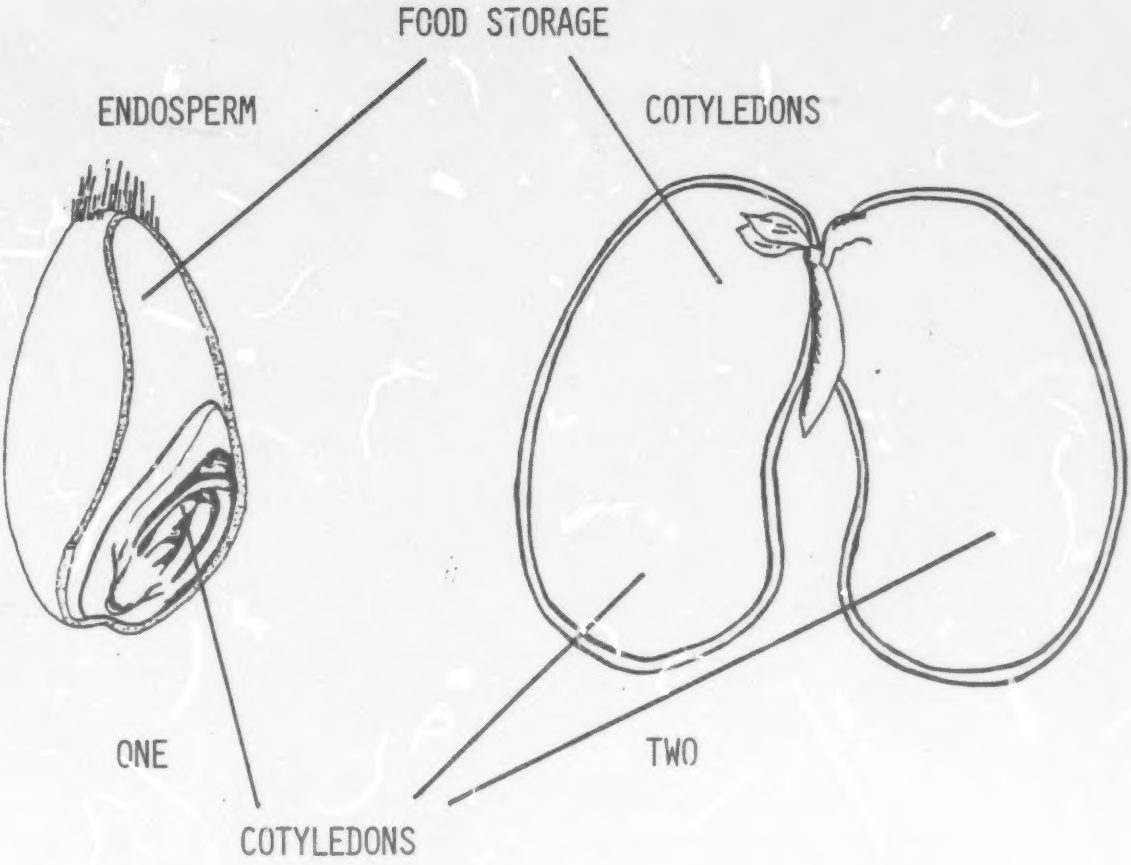
Courtesy of Washington State University, Pullman, Washington.

TYPICAL DICOT SEED


EPICOTYL
SEED COAT
COTYLEDONS
RADICLE

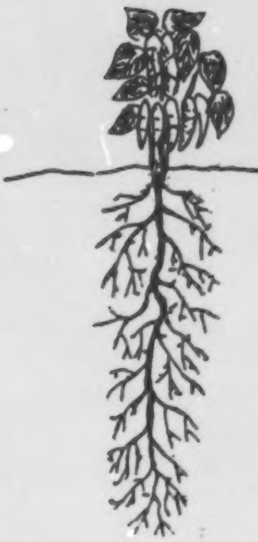
Courtesy of the Agronomy Department, North Dakota State University.

DIFFERENCES BETWEEN MONOCOT AND DICOT SEEDS

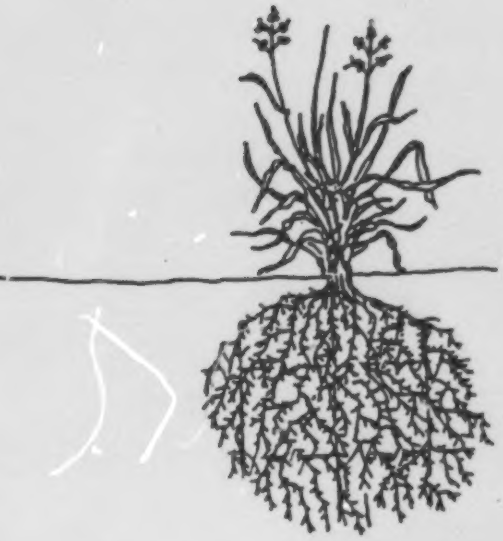

FOOD STORAGE
ENDOSPERM
COTYLEDONS
ONE
TWO
COTYLEDONS

Courtesy of the Agronomy Department, North Dakota State University.

MAJOR ROOT TYPES

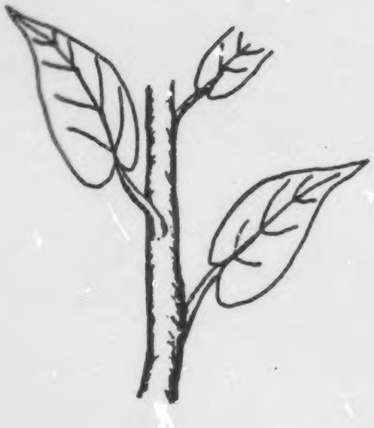


TAP ROOT



FIBROUS ROOT

TYPES OF LEAF ARRANGEMENTS



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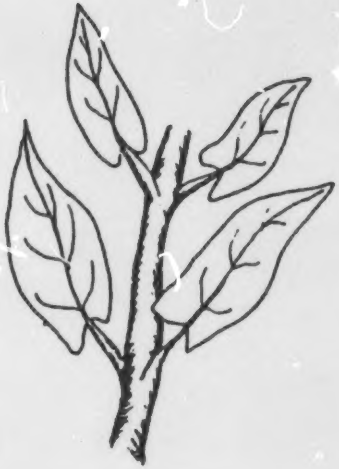

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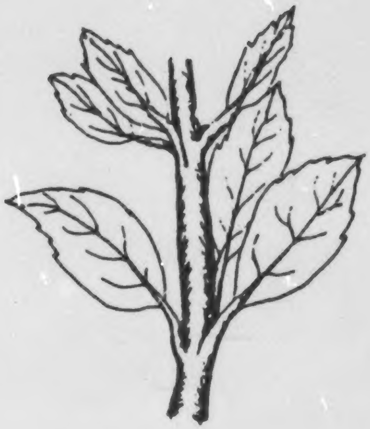
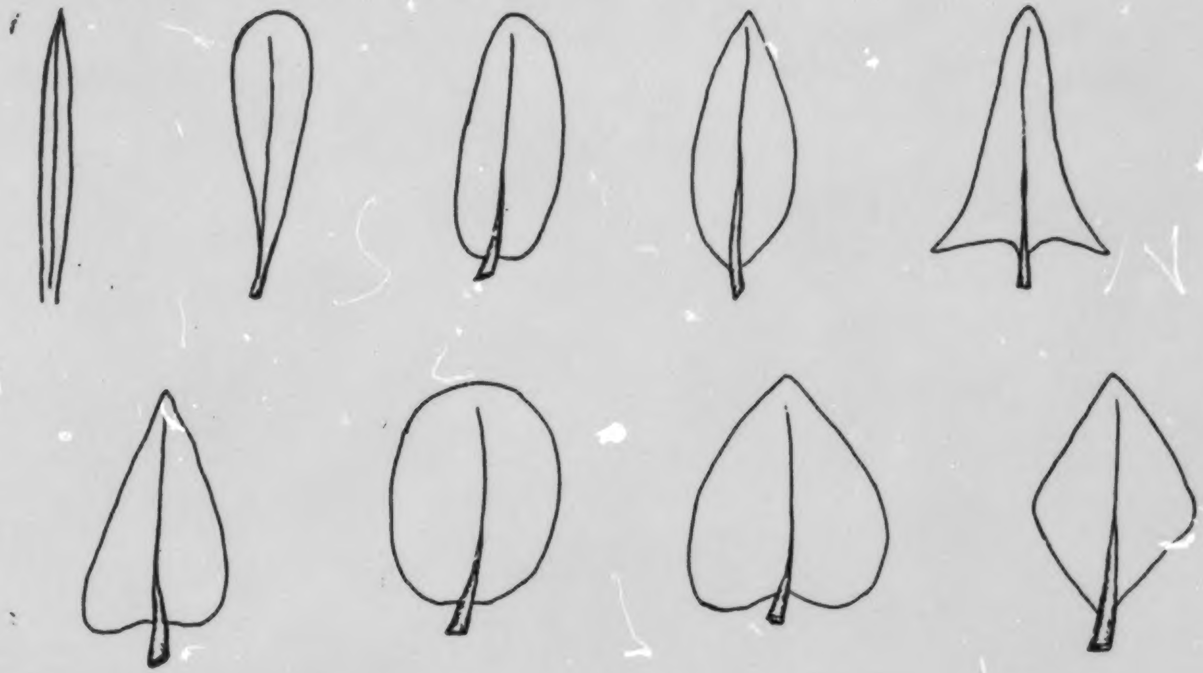


WHORLED

Courtesy of the Agronomy Department, North Dakota State University.

VARIOUS TYPES OF LEAF SHAPES



Courtesy of the Agronomy Department, North Dakota State University.

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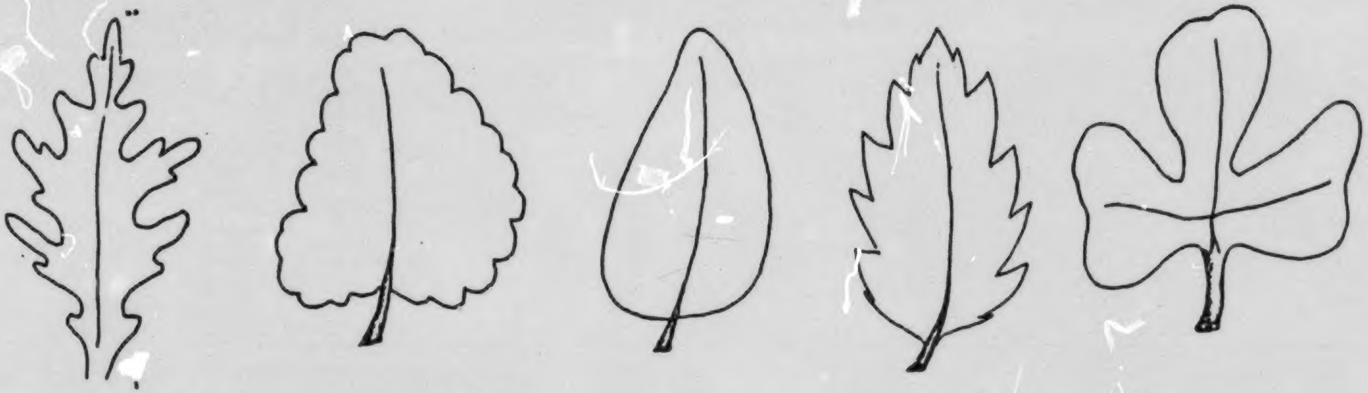
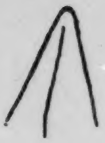
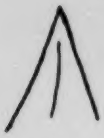
Courtesy of the Agronomy Department, North Dakota State University.

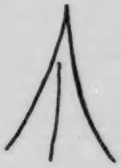
VARIOUS TYPES OF LEAF MARGINS

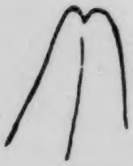


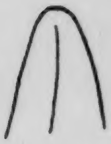
VARIOUS TYPES OF LEAF TIPS







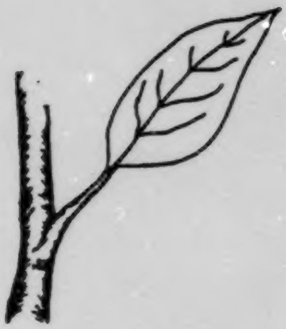




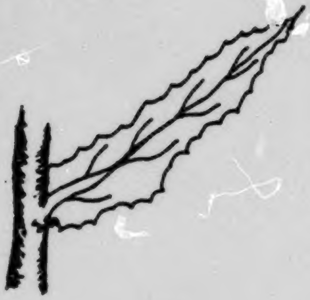
Courtesy of the Agronomy Department, North Dakota State University.

TYPES OF LEAF ATTACHMENT

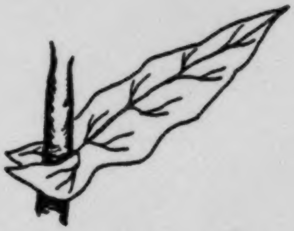
SIMPLE



PETIOLATE

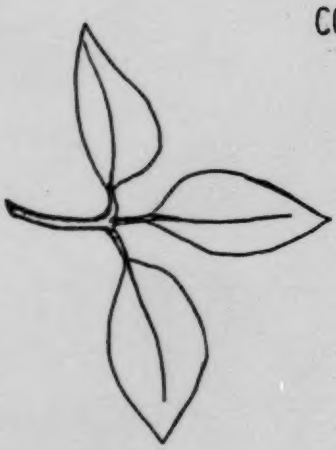


SESSILE

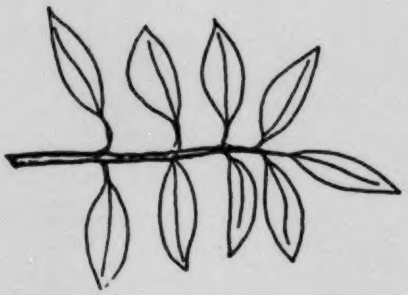


CLASPING

COMPOUND



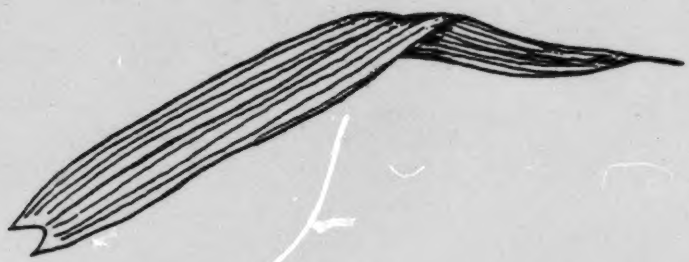
PALMATE



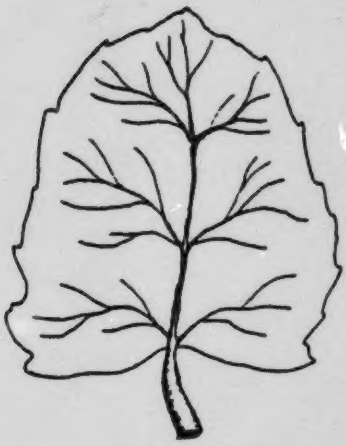
PINNATE

Courtesy of the Agronomy Department, North Dakota State University.

LEAF VENATION



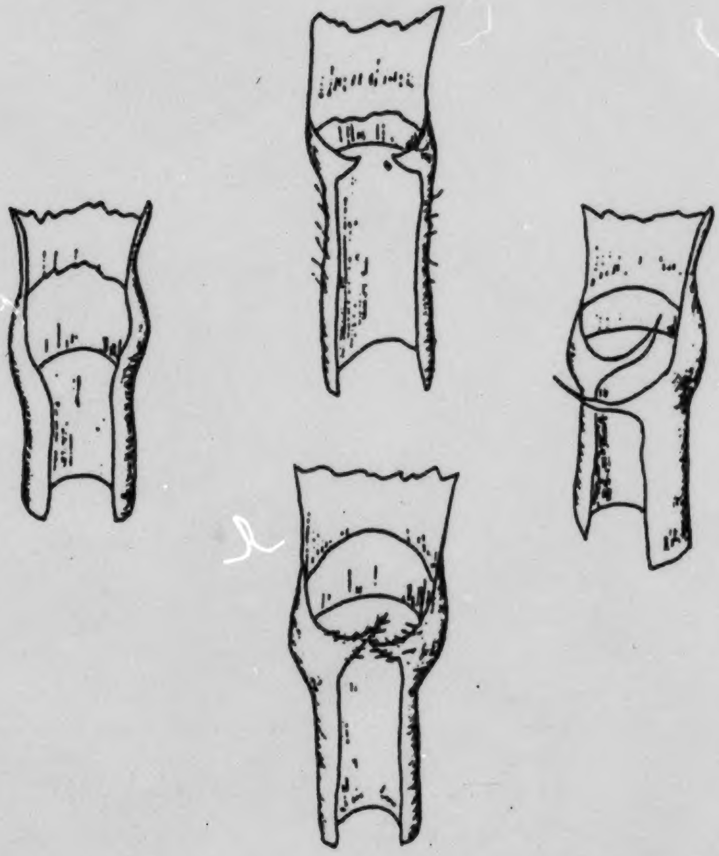
PARALLEL



NET

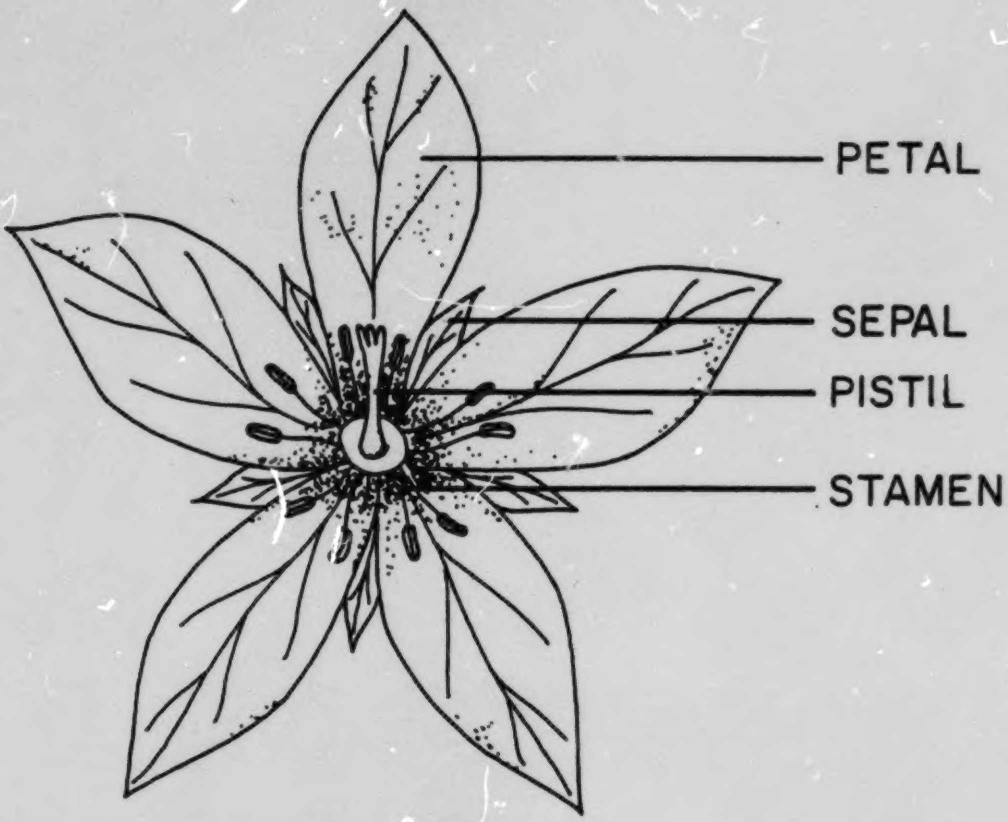
Courtesy of the Agronomy Department, North Dakota State University.

VARIOUS TYPES OF AURICLES



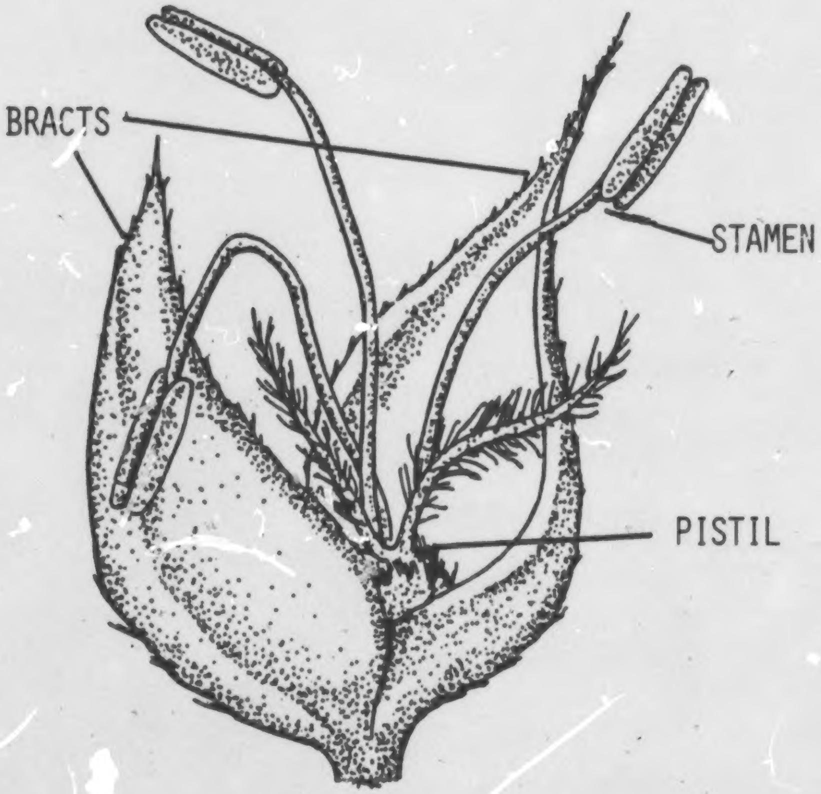
Courtesy of the Agronomy Department, North Dakota State University.

TYPICAL DICOT FLOWER


PETAL
SEPAL
PISTIL
STAMEN

Courtesy of Washington State University, Pullman, Washington.

TYPICAL GRASS FLOWER


BRACTS
STAMEN
PISTIL

Courtesy of the Instructional Materials Laboratory, University of Missouri-Columbia.

Job 3: Identifying Major North Dakota Crops and Their Uses.

Objectives:

The objectives of this job shall be met at a level predetermined by the instructor. The manner in which they are evaluated shall also be determined by the instructor.

Upon completion of this job, the students shall be able:

1. to identify and differentiate between major North Dakota crops and/or seeds including the following: hard red spring wheat, durum wheat, barley, oats, rye, corn, oil and non-oil type sunflowers, soybeans, flax, sugarbeets, dry edible beans, field peas, potatoes, alfalfa and sweet clover.
2. to list uses of those crops.

(Note: The instructor may exclude some of the above crops or include others.)

Guide Questions:

1. How is hard red spring wheat identified and what is it used for?
2. How is durum wheat identified and what is it used for?
3. How is barley identified and what is it used for?
4. How are oats identified and what are they used for?
5. How is rye identified and what is it used for?
6. How is corn identified and what is it used for?
7. How are sunflowers identified and what are they used for?
8. How are soybeans identified and what are they used for?
9. How is flax identified and what is it used for?
10. How are sugarbeets identified and what are they used for?
11. How are dry edible beans identified and what are they used for?
12. How are field peas identified and what are they used for?
13. How are potatoes identified and what are they used for?
14. How are alfalfa and sweetclover identified and what are they used for?

References:

Delorit, Richard J., Louis J. Greub, and Henry L. Ahlgren. Crop Production. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1974.

Messersmith, Calvin and Edward Deckard. Agronomy 103 Laboratory Guide. Agronomy Department, North Dakota State University, 1976.

Messersmith, Calvin and Edward Deckard. Agronomy 103 Lecture Guide. Agronomy Department, North Dakota State University, 1978.

Miller, Duane G., Gilbert A. Long, and Clarence E. Manning. Transparency Masters for Crop and Weed Identification. Washington State University, 1968.

Interest Approach:

Show the students seeds of a few crops they probably haven't seen before, sugarbeets, alfalfa, etc. and ask them to guess what they are. Then show them some Cheerios and have them try to identify them as "donut" seeds.

Key Facts:

I. Hard Red Spring Wheat.

  A. Identification.

    1. Seed. (Transparency 1)

      a. Small oval shaped.
      b. Reddish brown.
      c. Creased.

    2. Plant.

      a. Medium sized auricle with hair on tips. (Transparency 2)
      b. Many tillers develop.
      c. Spike type head. (Transparency 3)

        1) Many spikelets attached.
        2) Medium length awns on each flower.

  B. Uses.

1. Flour is highest quality for bread.

2. By-products of milling include wheat germ and bran.

II. Durum Wheat.

A. Identification.

1. Seed. (Transparency 4)

a. Longer and narrower than HRS wheat.
b. Lighter in color, amber.
c. Deeper crease.

2. Plant is similar to HRS wheat.

B. Uses.

1. Milled to produce seminola.

2. Seminola used to make pasta, such as spaghetti and macaroni.

III. Barley.

A. Identification.

1. Seed. (Transparency 5)

a. Longer oval shape, somewhat pointed at ends.
b. Light tan color.
c. Two classes.

1) Two-row - kernels are straight.
2) Six-row - 2/3 of kernels are bent from crowding.
3) Six-row most common in N.D.

2. Plant.

a. Auricles are long with hairs just below them. (Transparency 6)
b. Spike. (Transparency 7)

1) Awns are much longer.
2) Less flowers per node than wheat.
3) Six-row has more flowers than two-row.

B. Uses.

1. Malt.

a. 65% of N.D. barley used for malting compared to 35% in rest of U.S.

- b. Low protein.
- c. Used for brewing, industrial alcohol, and malt syrup.

2. Feed.

- a. High protein or lower quality.
- b. High protein barley more difficult to malt.

IV. Oats.

A. Identification.

1. Seed. (Transparency 8)

- a. Longer, more slender than barley.
- b. More pointed on one end.
- c. White in color.
- d. Smooth covering.

2. Plant.

- a. No auricle. (Transparency 9)
- b. Panicle type head. (Transparency 10)

B. Uses.

1. 80% is used for feed or exported.

- a. High quality protein.
- b. Stem often used as hay, especially when cut early.

2. Some is rolled or ground for human consumption.

3. Straw makes good quality bedding.

V. Rye.

A. Identification.

1. Seed. (Transparency 11)

- a. Tan, brown, or bluish-green.
- b. Shape is similar to wheat but longer and more slender.

2. Plant.

- a. Auricle very short with hairs below it.(Transparency 12)
- b. Resembles barley or wheat.

B. Uses.

1. Grain.

a. Feed.
b. Rye flour.
c. Whiskey and alcohol.

2. Straw.

a. Bedding.
b. Packing.
c. Paper.

3. Hay or pasture.

4. Green manure or cover crop.

VI. Corn.

A. Identification.

1. Seed. (Transparency 13)

a. Yellow, oblong shaped.
b. Indentation across top.
c. Embryo is light colored portion on bottom.

2. Plant.

a. Auricle not present. (Transparency 14)
b. Wider leaves than most other grasses.
c. Two separate flower parts. (Transparency 15)

1) Tassel has the stamens.
2) Ears have the pistils.

B. Uses.

1. 90 percent of grain used as feed.

2. 65 percent made into silage in N.D.

3. Some milled for corn starch.

4. Small amount used for alcohol and corn sweeteners.

VII. Sunflowers.

A. Identification.

1. Seed.

a. Black, oval shaped.
b. Non-oil type has white stripes, slightly larger.

2. Plant.

a. Large leaves with serrated edge and rough surface.
b. Stem is thick and long with a rough surface.
c. Head very prominent. (Transparency 16)

1) Base is large and round.
2) Ray flowers - around outside, have large yellow petals.
3) Disk flowers - on inside, produce pollen and seeds.

B. Uses.

1. Oil type.

a. Edible and industrial oils.
b. Being considered as a fuel.

2. Non-oil type.

a. Whole roasted seeds.
b. Hulled nuts used for baking and candies.
c. Birdseed.

VIII. Soybeans.

A. Identification.

1. Seed.

a. Round to oval and smooth.
b. Generally yellow, may be green or brown.
c. Some have a dark spot where attached to pod.

2. Plant.

a. Oval shaped leaves with palmate attachment.
b. Flower is small and develops pods.

B. Uses.

1. Edible and industrial oil.
2. Leftover meal used as a livestock protein supplement or as a meat extender for hamburger or sausage.

IX. Flax.

A. Identification.

1. Seed.

a. Flat, oval shaped.
b. Smooth shiny seed coat.
c. Tan to brown color.

2. Plant.

    a. Leaves are long and narrow with parallel venation.
    b. Slender woody stem.
    c. Flower has five petals, either blue or white.
    d. Flower develops into a round boll, similar to a pod, which contains ten seeds.

B. Uses.

1. Fiber.

    a. Linen cloth.
    b. High quality paper used for cigarettes and documents.

2. Oil.

    a. Paints and varnishes.
    b. Linoleum.
    c. Inks.

X. Sugarbeets.

A. Identification.

1. Seed.

    a. Small, irregular shaped.
    b. Light to dark brown.

2. Plant. (Transparency 17)

    a. Rosette type stem and leaves.
    b. No flower produced until second year.
    c. Large thick tap root.

B. Uses.

1. Sugar.

2. By-products used as livestock feed.

    a. Beet pulp.
    b. Molasses.
    c. Beet tops.

XI. Dry Edible Beans.

A. Identification.

1. Seed.

a. Pinto bean is larger and is brown and tan mottled.
b. Navy bean is smaller and white.
c. Both are oval shaped.

2. Plant.

a. Similar to soybean plant.
b. Pinto bean leaf is more pointed.
c. Pinto bean pod is longer and flatter than navy bean.

B. Uses.

1. Beans for human consumption.

2. May also be grown for forage or green manure crop.

XII. Field Peas.

A. Identification.

1. Seed.

a. Similar to soybean, lighter in color.
b. Does not have dark spot where attached to pod.
c. Surface may be wrinkled.

2. Plant.

a. Leaves are more rounded and darker than soybeans.
b. Flower petals are reddish-purple or white.

B. Uses.

1. Human consumption in soups.

2. Livestock and poultry feed.

a. Seed.
b. Hay.
c. Pasture.

XIII. Potatoes.

A. Identification.

1. Seeds not used for propagating.

2. Plant.

a. Leaves are rounded oval shape, with pinnate attachment, nine or more leaflets.

    b. Stem is hairy and branched.
    c. Flower may be white, rose, or purple in color.

B. Uses.

1. Human consumption.

    a. Forty percent as fresh potatoes.
    b. One third is frozen.
    c. Rest are made into chips or shoestrings, are dehydrated or canned.

2. Small amount used as livestock feed.

XIV. Alfalfa and Sweetclover Hay.

A. Identification.

1. Seed.

    a. Both are small, brown, yellow or green, with an indentation.
    b. Alfalfa is kidney shaped with indentation at side.
    c. Sweet clover has indentation near the top.

2. Plant. (Transparency 18)

    a. Both have three leaflets on each leaf with similar shape.
    b. Alfalfa has a serrated leaf tip, sweet clover has two thirds of the leaf serrated.

B. Uses.

1. Both used mainly as a forage.

2. May be fed as dried hay, chopped and made into haylage, or ground and pelleted.

3. Sweet clover often used as a cover crop and plowed under to improve soil condition.

Student Learning Activities:

1. Have the students examine seed samples and plant mounts.

2. Have students examine live plants either in a greenhouse or in the field.

3. Have students complete the enclosed worksheet.

Worksheet #1.

Instructions: Write a short explanation of how to tell the difference between the following seeds and plants.

SEEDS

1. HRS and Durum wheat -

2. Barley, Oats, and Rye -

3. Oil and Non-oil Type Sunflowers -

4. Soybeans and Field Peas -

5. Alfalfa and Sweet Clover -

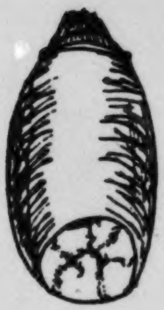
PLANTS

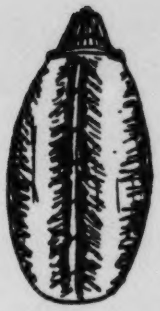
6. Wheat, Barley, Oats, and Rye -

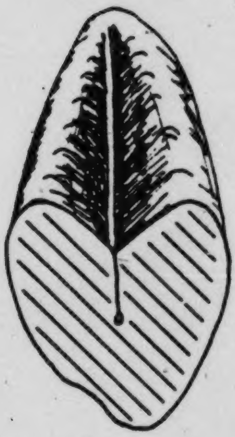
7. Soybeans, Pinto Beans, and Field Peas -

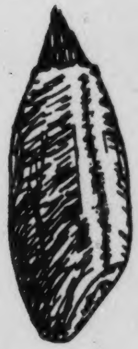
8. Alfalfa and Sweetclover -

HARD RED SPRING WHEAT



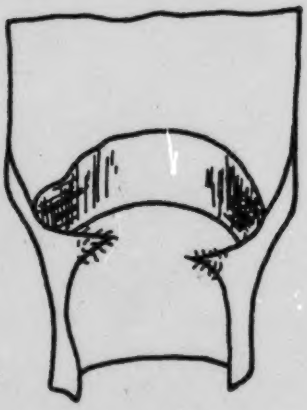






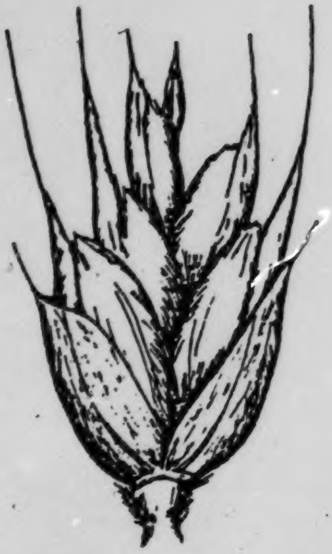
Courtesy of Washington State University, Pullman, Washington.

WHEAT AURICLE



Courtesy of Washington State University, Pullman, Washington.

WHEAT SPIKELET



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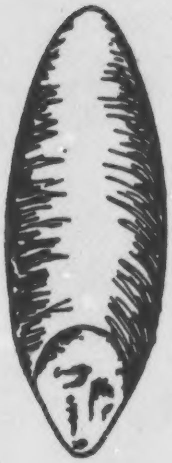
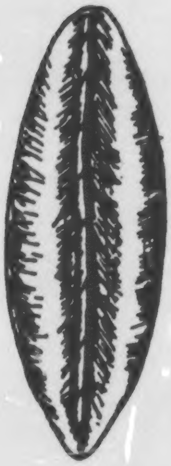
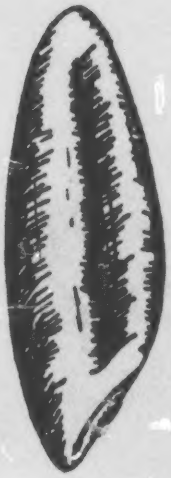
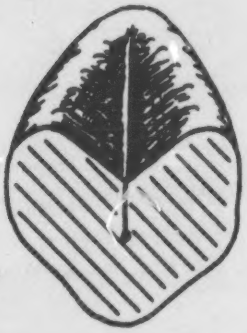
AMBER DURUM WHEAT



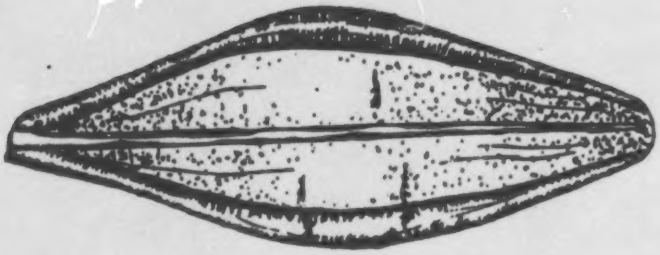




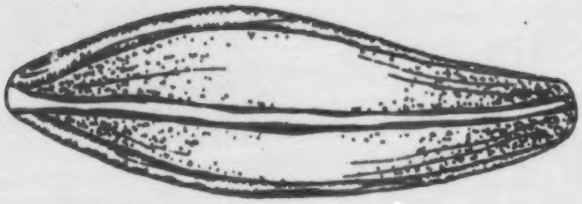


Courtesy of Washinton State University, Pullman, Washington.

BARLEY



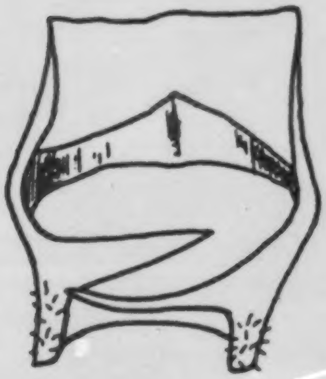
TWO ROW



SIX ROW

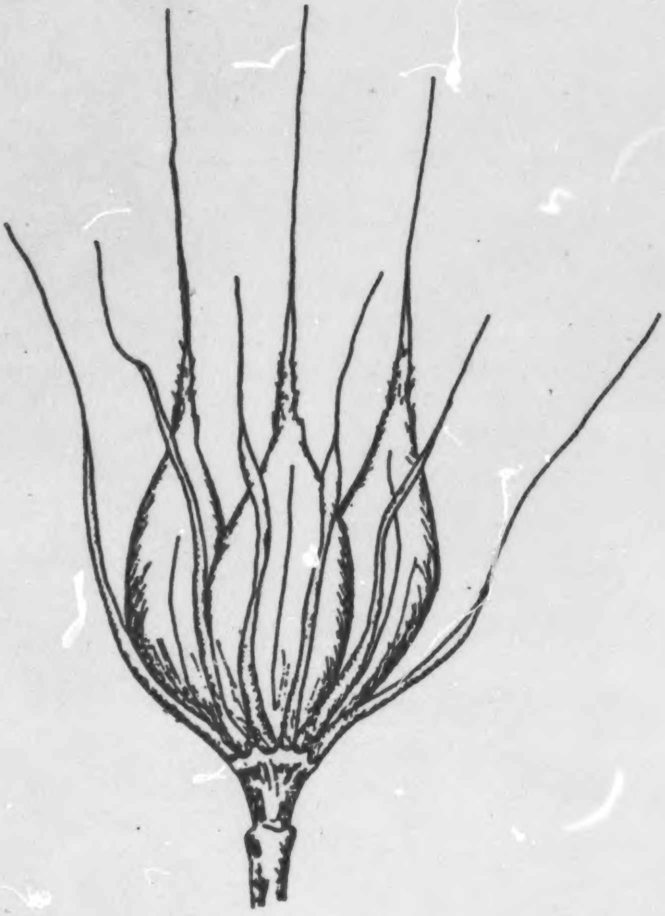
Courtesy of Washington State University, Pullman, Washington.

BARLEY AURICLE



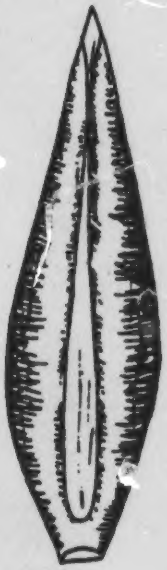
Courtesy of Washington State University, Pullman, Washington.

BARLEY SPIKELET



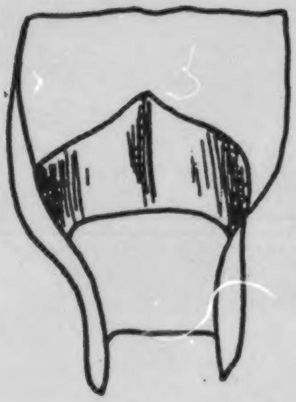
Courtesy of the Agronomy Department, North Dakota State University.

OAT SEED



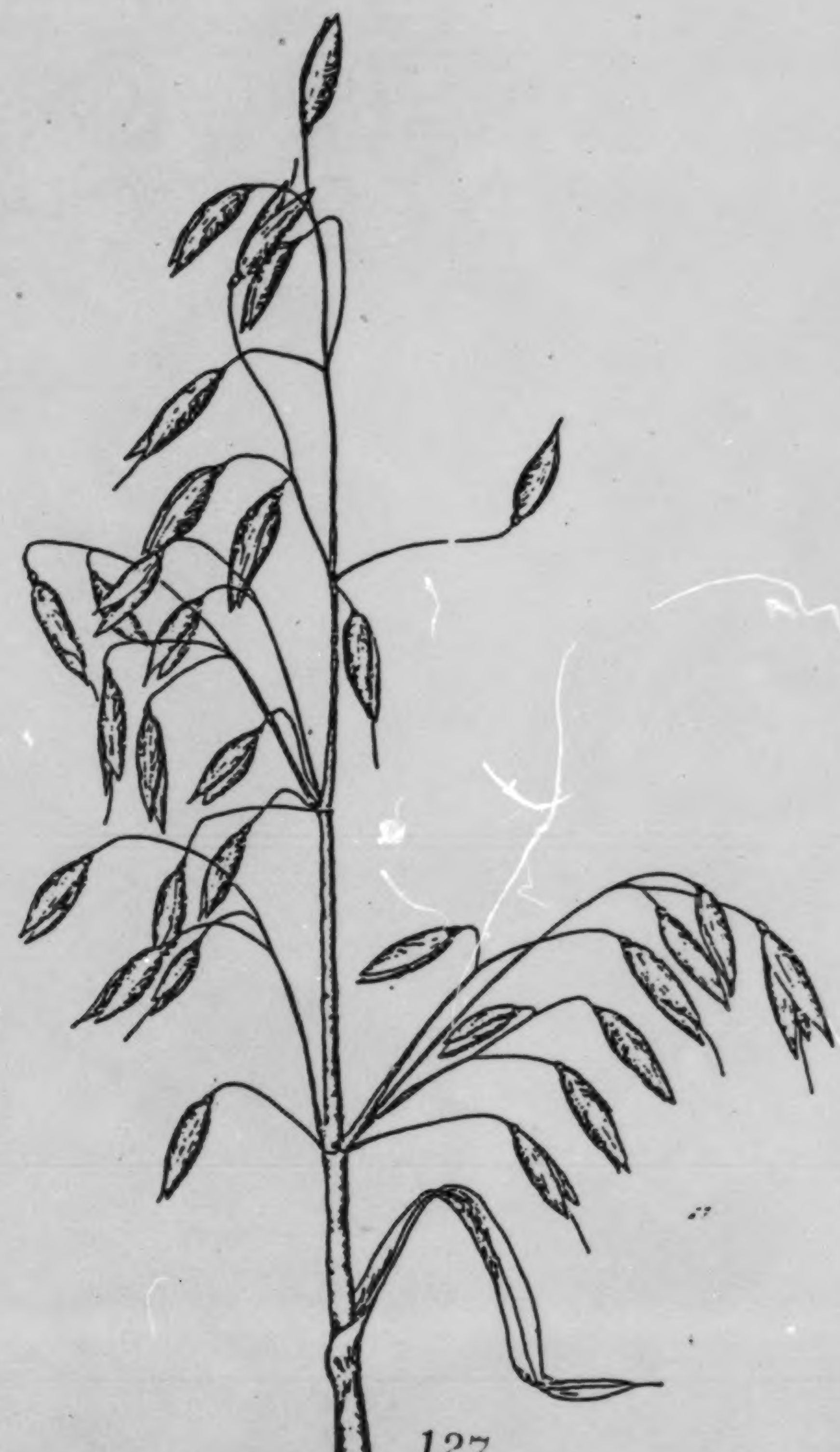
Courtesy of Washington State University, Pullman, Washington.

OATS AURICLE



Courtesy of Washington State University, Pullman, Washington.

OATS HEAD



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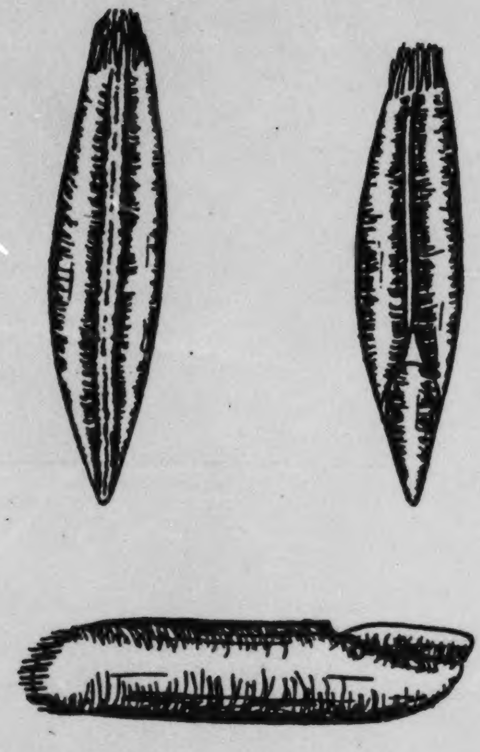
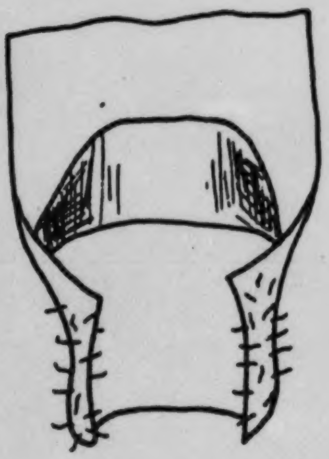
RYE SEEDS



Courtesy of Washington State University, Pullman, Washington.

RYE AURICLE



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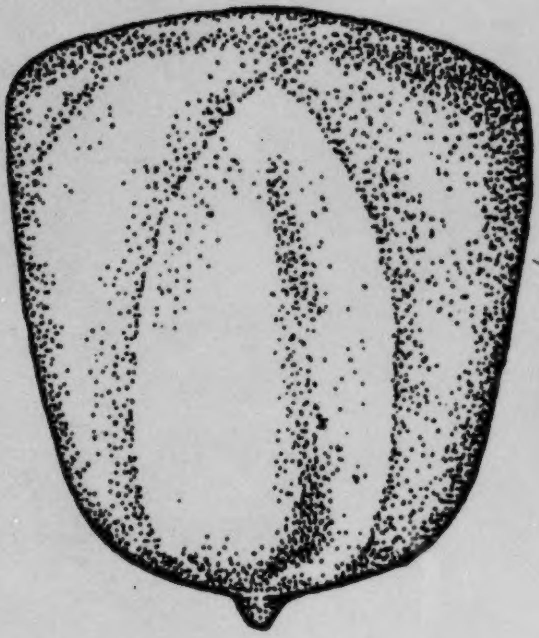
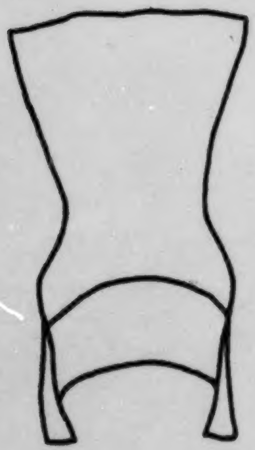
CORN SEED



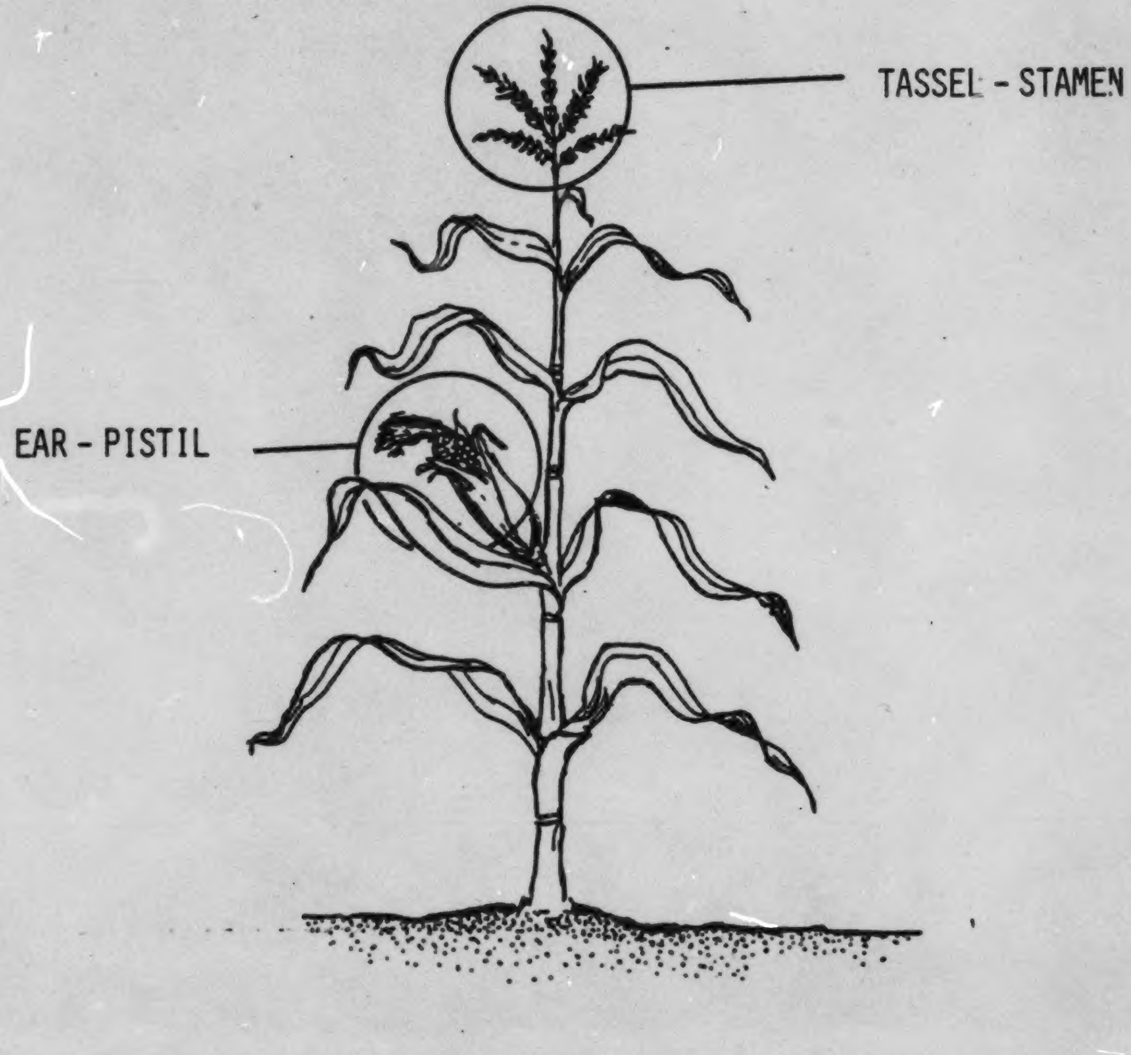
Courtesy of the Instructional Materials Laboratory, University of Missouri-Columbia.

CORN AURICLE



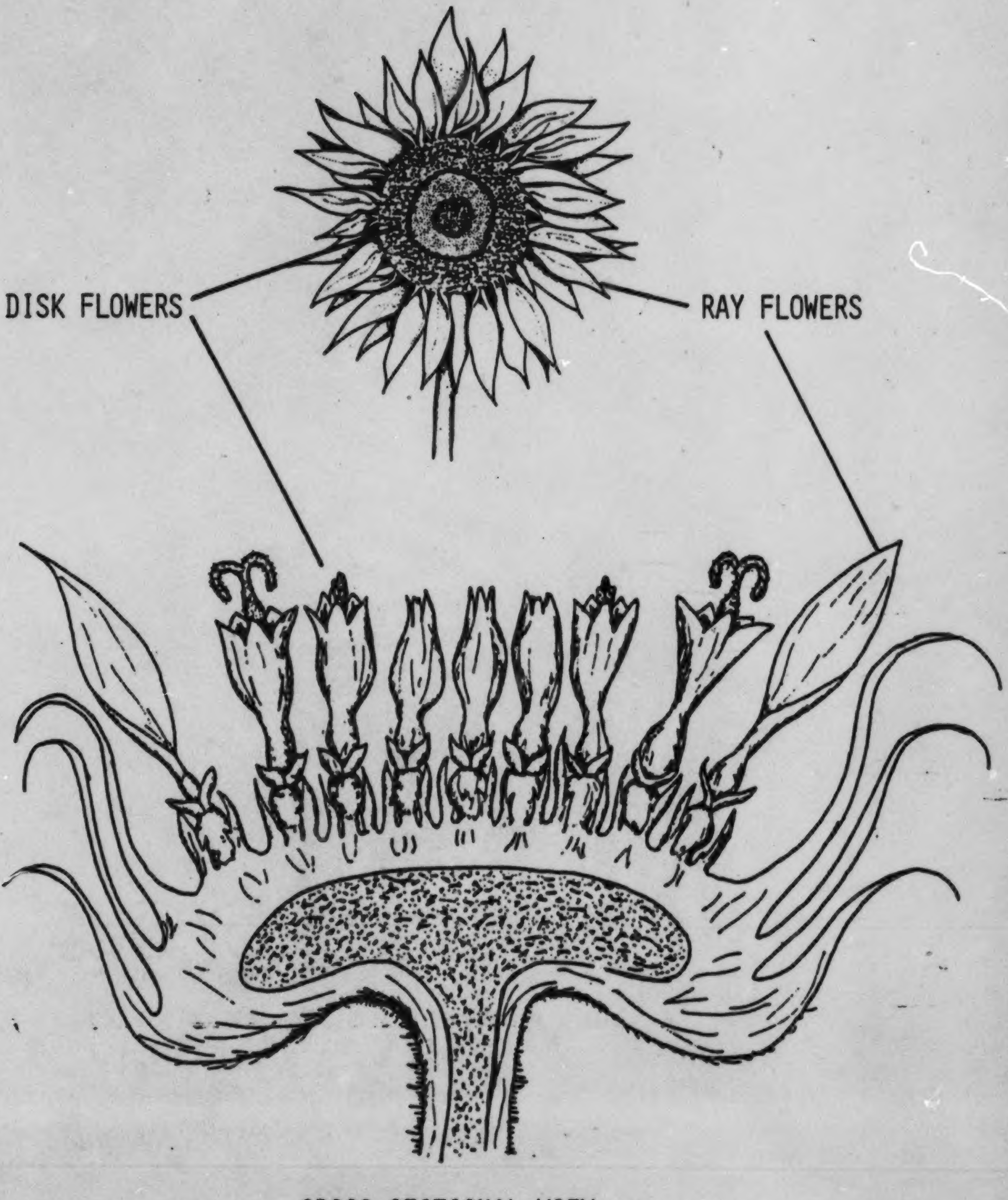
Courtesy of Washington State University, Pullman, Washington.

FLOWERING PARTS OF CORN


TASSEL - STAMEN
EAR - PISTIL

Courtesy of the Instructional Materials Laboratory, University of Missouri-Columbia.

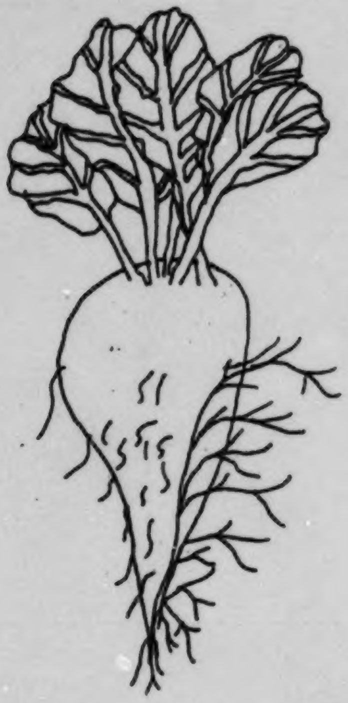
SUNFLOWER HEAD


DISK FLOWERS
RAY FLOWERS

CROSS-SECTIONAL VIEW

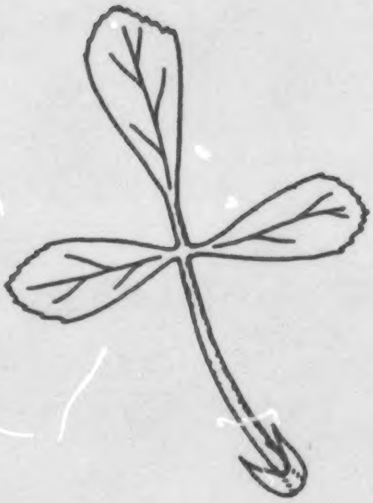
Courtesy of the Agronomy Department, North Dakota State University.

SUGARBEET PLANT

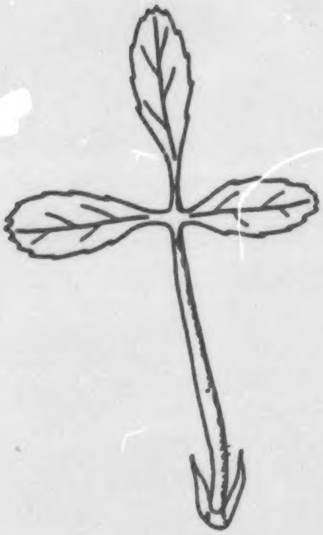


Courtesy of the Agronomy Department, North Dakota State University.

ALFALFA AND SWEETCLOVER LEAVES



ALFALFA



SWEETCLOVER

Courtesy of Washington State University, Pullman, Washington.

Job 4: Identifying Weeds.

Objectives:

The objectives of this job shall be met at a level predetermined by the instructor. The manner in which they are evaluated shall also be determined by the instructor.

Upon completion of this job, the student shall be able:

1. to define the terms prohibited noxious and restricted noxious weeds.
2. to identify the prohibited noxious weeds.
3. to identify the restricted noxious weeds.

Guide Questions:

1. What are prohibited noxious and restricted noxious weeds?
2. How are the prohibited weeds identified?
3. How are the restricted weeds identified?

References:

Miller, Duane G., Gilbert A. Long, and Clarence E. Manning. Transparency Masters For Crop And Weed Identification. Washington State University, 1968.

Mitch, Larry W. Identifying Weeds and Their Seeds. Cooperative Extension Service, North Dakota State University, Fargo, North Dakota.

Interest Approach:

Ask the students what would happen if both teams in a basketball game had similar uniforms. Point out the importance of being able to recognize your opponent. Explain that this is also important in combating weeds in the field and weed seeds in grain, especially when some weed seeds and plants are very similar to crops.

Key Facts:

I. Defining Prohibited Noxious and Restricted Noxious Weeds.
    A. Classified by North Dakota seed laws and regulations.
    B. Prohibited.
        1. Deep rooted perennials which are difficult to control by tillage or chemicals.

2. Reproduce by seeds and spread by roots or underground stems.

C. Restricted.

1. Annuals or perennials which spread rapidly.

2. Many are difficult to separate from crop seeds.

3. Can be controlled by good tillage or chemical methods.

4. Very small amount allowed in seed for planting.

II. Prohibited Noxious.

A. Canada thistle.

1. Seed. (Transparency 1)

   a. Dull brownish color.
   b. Oblong or slightly curved, 3 mm (1/8 inch) long.
   c. Ring and point on one end.

2. Plant. (Transparency 2)

   a. 30 - 90 cm (1 - 3 feet) tall, widely branched at top.
   b. Leaves.

      1) Green with gray underside.
      2) Curled edge with spiny margin.

   c. Flower.

      1) Light purple with tufts of hair.
      2) Plants produce either male or female flowers, never both.

B. Field Bindweed.

1. Seed. (Transparency 3)

   a. Grayish brown, dull seed coat.
   b. Two flat sides, one rounded with blunt point at one end.
   c. 3 mm (1/8 inch) long.

2. Plant. (Transparency 4)

   a. Stem is slender and twines along ground or other plants.
   b. Leaves.

        1) Generally narrow, slightly tapered, with a spreading pointed base.
        2) May vary considerably.

    3. Flower.

        a. Funnel shaped, about 2.5 cm (1 inch).
        b. Pink or white.
        c. Two small scale-like leaves on flower stalk somewhat below the flower.
        d. Seed capsule is egg shaped with 2-4 seeds.

C. Hoary Cress.

    1. Seed. (Transparency 5)

        a. Reddish brown to brown.
        b. Oval to somewhat pointed, 1.5 mm (1/16 inch) long.
        c. Seed coat is rough with a small groove.

    2. Plant. (Transparency 6)

        a. 10 - 40 cm (4 - 16 inches) tall, branching only at the top.
        b. Leaves.

            1) Oblong, 2.5 - 10 cm (1 - 4 inches) long.
            2) Wavy or toothed margin.
            3) Grayish green with fine hairs.
            4) Upper leaves clasp to stem.

        c. Flowers.

            1) White.
            2) Large cluster of flowers at top.
            3) Seed pods are flat and heart shaped.

D. Leafy Spurge.

    1. Seed. (Transparency 7)

        a. Light to dark grayish brown with small dark brown flecks.

        b. Oblong and tapered at one end with a definite crease on one side, 1.5 mm (1/16 inch) long.

    2. Plant. (Transparency 8)

        a. Stem is smooth and erect, branching near the top, 30 - 60 cm (1 - 2 feet) tall.
        b. Leaves are long and narrow 2.5 - 8 cm (1 - 3 inches) long.
        c. Flowers are yellowish-green in cluster at top.

E. Perennial Sowthistle.

1. Seed. (Transparency 9)

a. Dark reddish brown.
b. Rounded and tapering to one end, 3 mm (1/8 inch) long.
c. 5 - 7 ribs and cross wrinkled.

2. Plant. (Transparency 10)

a. Stem is smooth and erect, 90 - 200 cm (3 - 7 feet) tall.
b. Leaves are light green with irregularly toothed and spiny margin, 10 - 20 cm (4 - 8 inches) long.
c. Flowers are deep yellow, 4 cm (1.5 inches) wide.

F. Russian Knapweed.

1. Seed. (Transparency 11)

a. Cream colored.
b. Flattened, rounded at one end, tapering to a point at the other.

2. Plant. (Transparency 12)

a. Stem is woody, with soft, white hairs and many branches, 60 - 90 cm (2 - 3 feet) tall.
b. Leaves.

    1) Grayish green.
    2) Larger at base with lobed margin.
    3) Smaller and smooth at top.

c. Both stem and leaves have a distinctive bitter taste.
d. Flowers are lavender to white, 12 mm (1/2 inch) wide.

III. Restricted Noxious Weeds.

A. Dodder.

1. Parasite commonly found on alfalfa.

2. Seed. (Transparency 13)

a. Brown to light tan, often speckled.
b. Generally round in shape, 1.5 mm (1/16 inch) long.
c. Flattened, irregular or pointed seeds also found.
d. Somewhat resembles alfalfa only smaller.

3. Plant. (Transparency 14)

a. Yellow vine.

   - b. Attaches to stem of host plant.
   - c. No leaves or roots.
   - d. Flowers are white, produced in clusters.

B. Field Pennycress.

1. Seed. (Transparency 15)

   - a. Dark brown or black with grayish cast.
   - b. Oblong and flattened, 1.5 mm (1/16 inch) long.
   - c. Ridges resemble a thumbprint.

2. Plant. (Transparency 16)

   - a. Stem is erect, 10 - 60 cm (4 - 24 inches) tall with flowering branches on upper half.
   - b. Leaves.

      - 1) Oblong, thick, and smooth, 2.5 - 6 cm (1 - 2 1/2 inches) long.
      - 2) Margin is usually toothed.
      - 3) Leaves alternate and clasping.

   - c. Flower.

      - 1) White clusters on long stem.
      - 2) 3 mm (1/8 inch) wide.
      - 3) Seed pods are flat, winged and notched at the top.

   - d. Plant has a distinct onion-like odor.

C. Hedge Bindweed.

1. Seed. (Transparency 17)

   - a. Resembles Field Bindweed in shape.
   - b. Almost twice as large, 4.5 mm (3/16 inch) long.
   - c. Black to dark brown with shiny seed coat.

2. Plant. (Transparency 18)

   - a. Vine spreading up to 3 m (10 feet) long, twining over plants and objects.
   - b. Leaves.

      - 1) Similar to Field Bindweed.
      - 2) Smooth and large, generally triangular in shape.
      - 3) Have 2 angles at each basal point.

   - c. Flower also similar to Field Bindweed, except with two large bracts enclosing the base instead of scale-like leaves below flower.

D. Quackgrass.

1. Seed. (Transparency 19)

   a. Straw colored.
   b. Long, flat, tapers to both ends.
   c. 6 - 9 mm (1/4 - 3/8 inch) long.

2. Plant. (Transparency 20)

   a. Stem is leafy, 45 - 75 cm (18 - 30 in.) tall.
   b. Leaves.

      1) Thin, soft, flat, 6 - 12 mm (1/4 - 1/2 in.) wide.
      2) Dark green.
      3) First leaves in spring covered with dense fine gray hair at the base.

   c. Seed heads are 5 - 10 cm (2 - 4 in.) long with 3 to 7 seeds per spikelet.

E. Wild Mustard.

1. Seed. (Transparency 21)

   a. Black or reddish before ripe, black when ripe.
   b. Round, 1.5 mm (1/16 in.) diameter.

2. Plant. (Transparency 22)

   a. Stout, widely branched, 30 - 90 cm (1 - 3 ft.) tall.
   b. Leaves.

      1) Hairy, 2.5 - 8 cm (1 - 3 in) wide, 5 - 20 cm (2 - 8 in.) long.
      2) Irregular or toothed margins.
      3) Arranged alternately.

   c. Flowers are yellow on long branches.
   d. Seed pods are slender, 2.5 - 5 cm (1 - 2 in.) long with several seeds.

F. Wild Oats.

1. Seed. (Transparency 23)

   a. Similar to oats in shape and size.
   b. May be reddish-brown, black, white or yellow.
   c. May have an awn.
   d. "Sucker mouth" at base.
   e. May have tufts of hair around base.

2. Plant. (Transparency 24)

   a. Also similar to oats.
   b. Head usually more open.

Student Learning Activities:

1. Have students examine seed samples and plant mounts, or slides.
2. Have students examine live plants, either in a greenhouse or in the field.
3. Have students complete the enclosed worksheet.

Worksheet #1

Instructions: Write a short explanation of how to tell the difference between the following seeds and plants.

SEEDS

1. Canada Thistle and Perennial Sowthistle -

2. Field Bindweed and Hedge Bindweed -

3. Hoary Cress, Field Pennycress, and Flax -

4. Russian Knapweed and Leafy Spurge -

5. Dodder, Alfalfa, and Sweetclover -

6. Quackgrass, Wild Oats, and Tame Oats -

PLANTS

7. Canada Thistle and Perennial Sowthistle -

8. Field Bindweed and Hedge Bindweed -

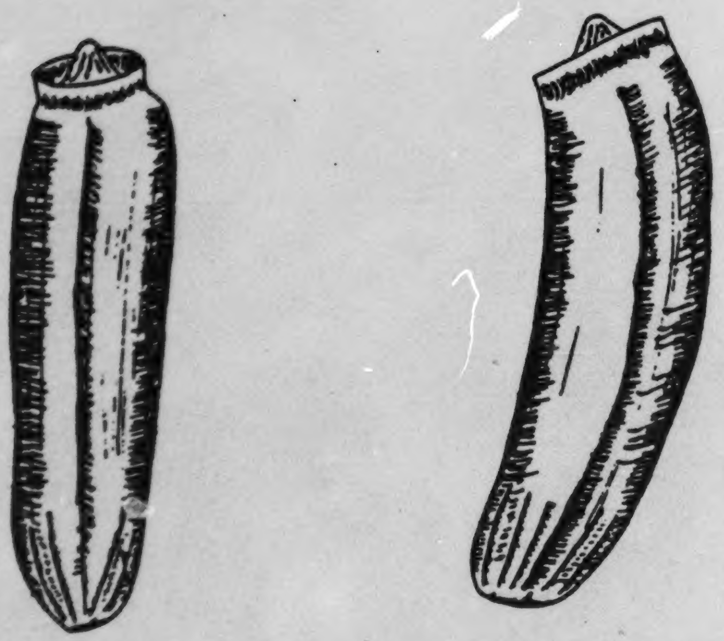
Worksheet #1 (Continued)

9. Hoary Cress and Field Pennycress -

10. Wild Mustard and Russian Knapweed -

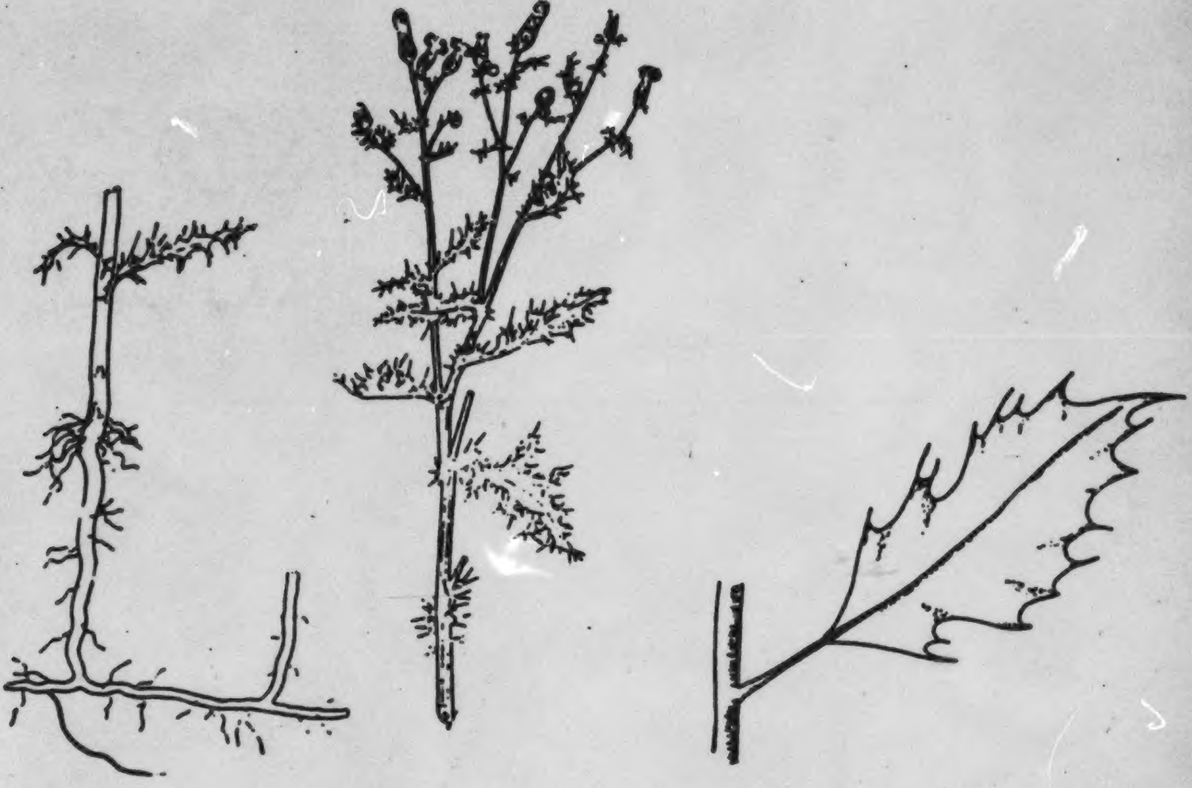
11. Quackgrass and Wild Oats -

CANADA THISTLE SEED



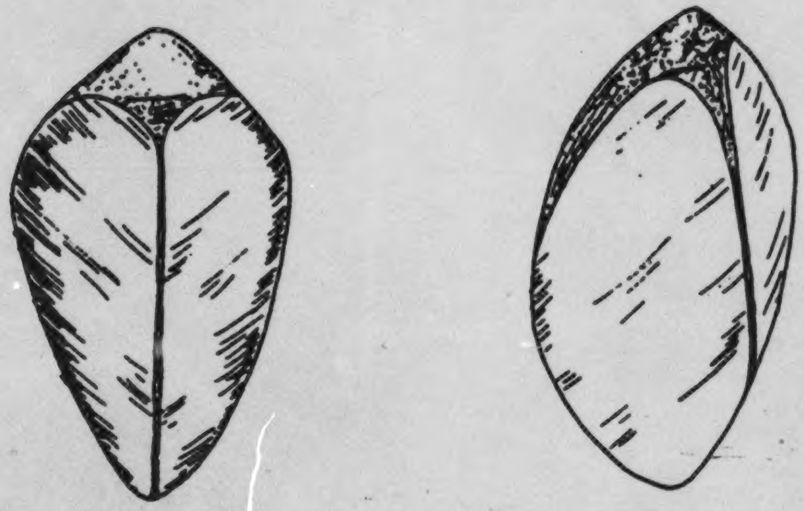
Courtesy of Washington State University, Pullman, Washington.

CANADA THISTLE



Courtesy of Washington State University, Pullman, Washington.

FIELD BINDWEED SEED



Courtesy of Washington State University, Pullman, Washington.

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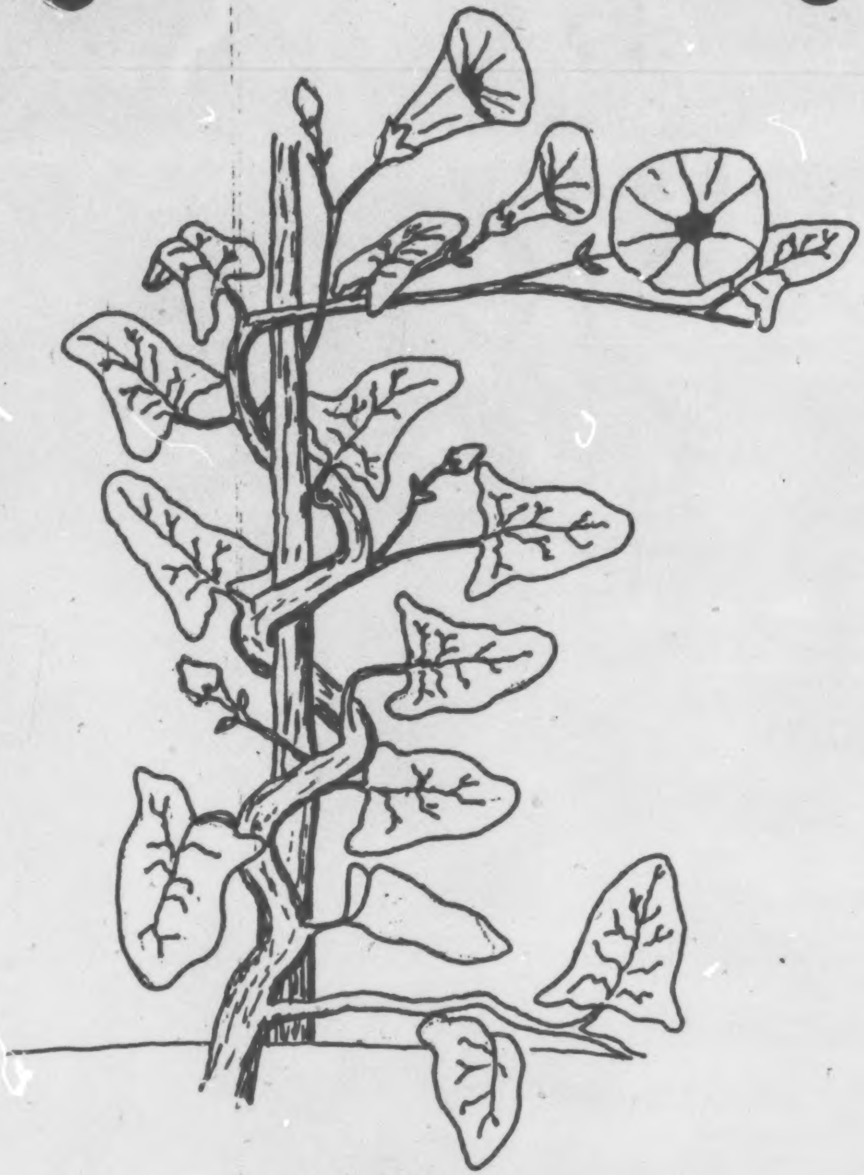
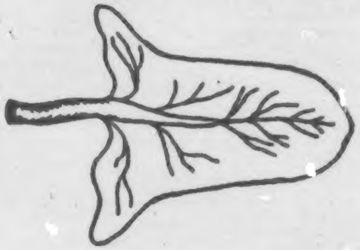
FIELD BINDWEED

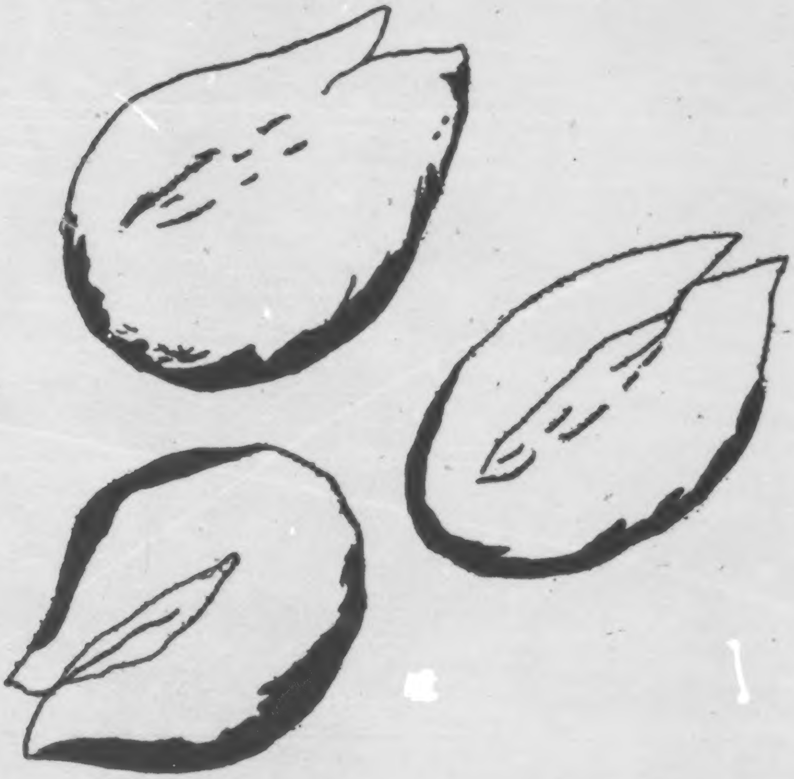


PLANT



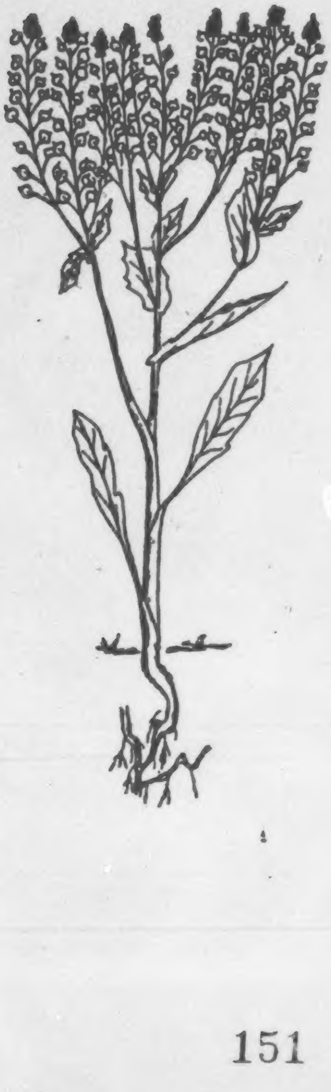
LEAF

HOARY CRESS SEED



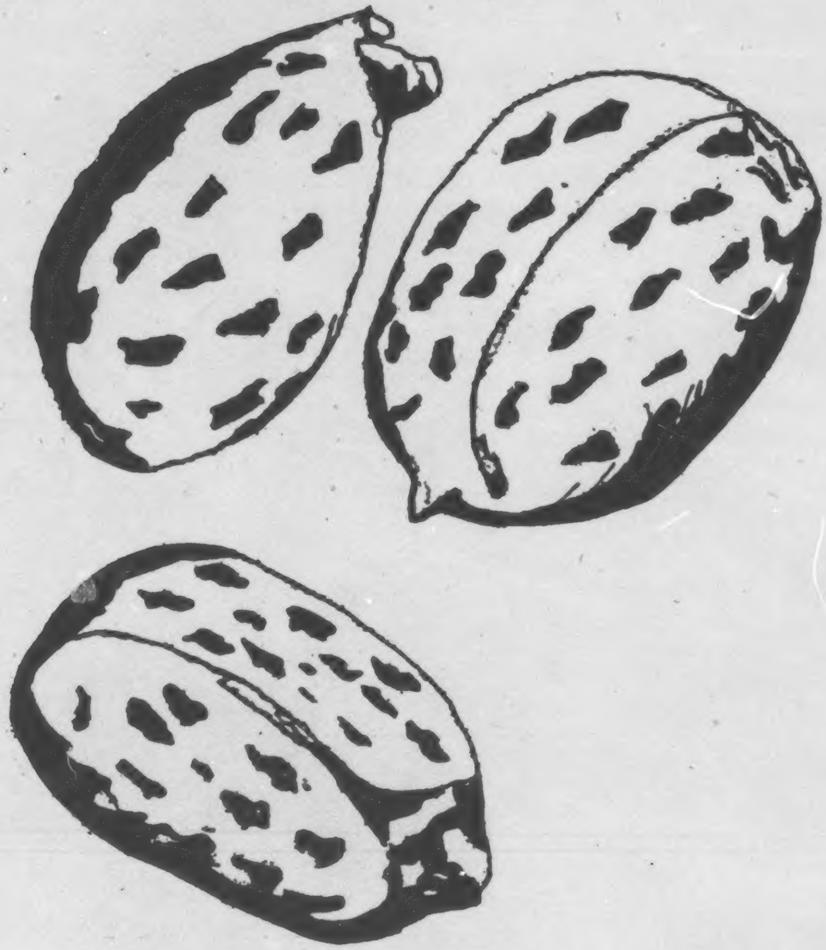
Courtesy of the Cooperative Extension Service, North Dakota State University.

HOARY CRESS



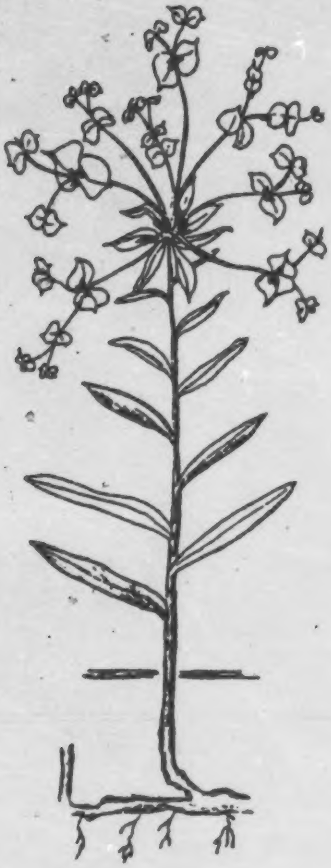
Courtesy of the Cooperative Extension Service, North Dakota State University.

LEAFY SPURGE SEED



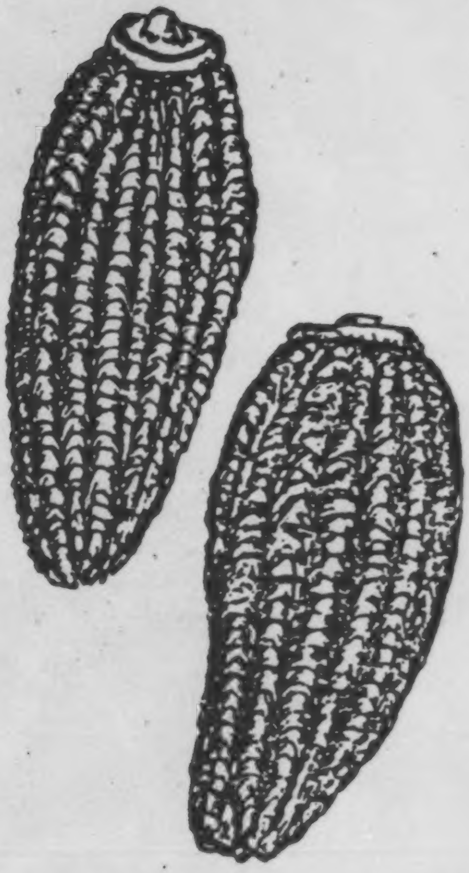
Courtesy of the Cooperative Extension Service, North Dakota State University.

LEAFY SPURGE



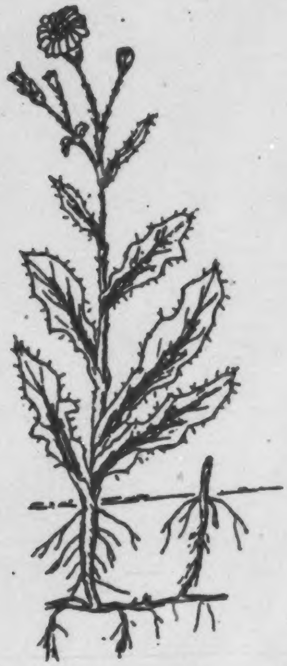
Courtesy of the Cooperative Extension Service, North Dakota State University.

PERENNIAL SOWTHISTLE SEED



Courtesy of the Cooperative Extension Service, North Dakota State University.

PERENNIAL SOWTHISTLE



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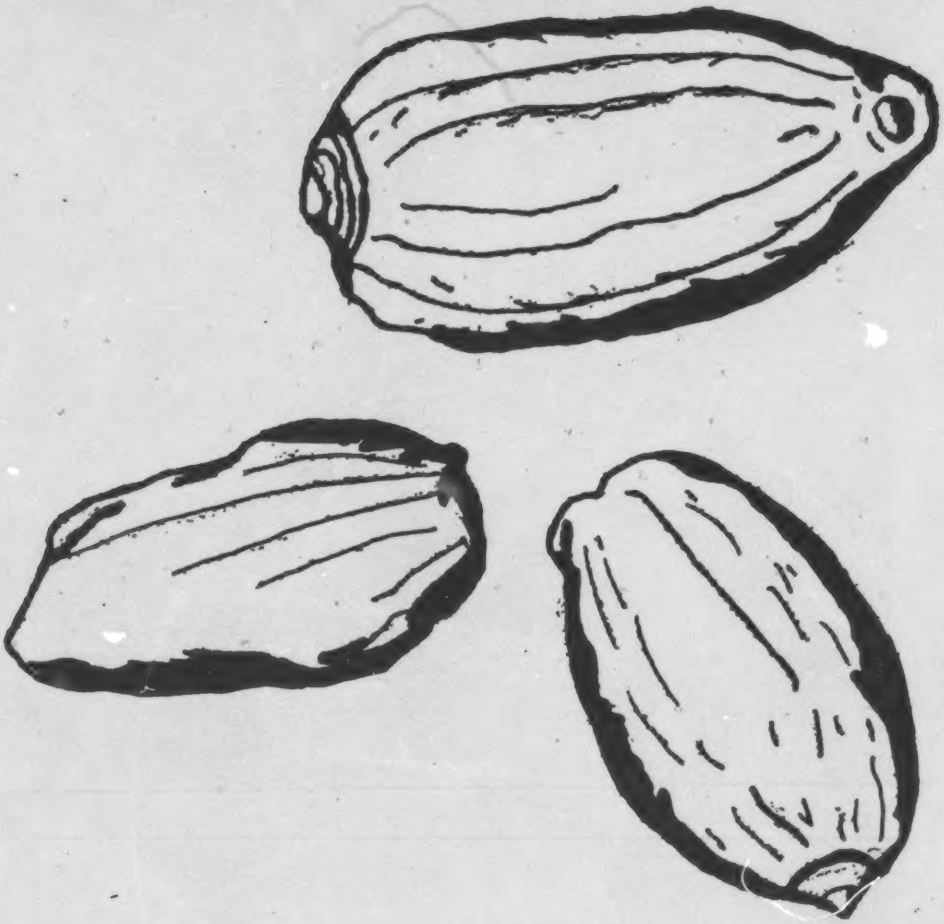
RUSSIAN KNAPWEED SEED



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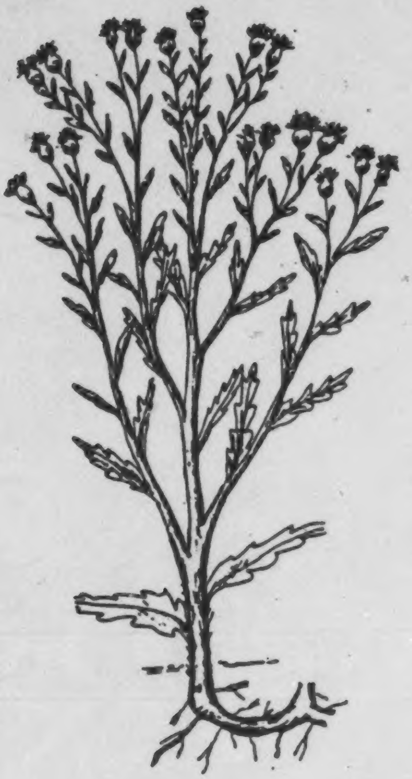
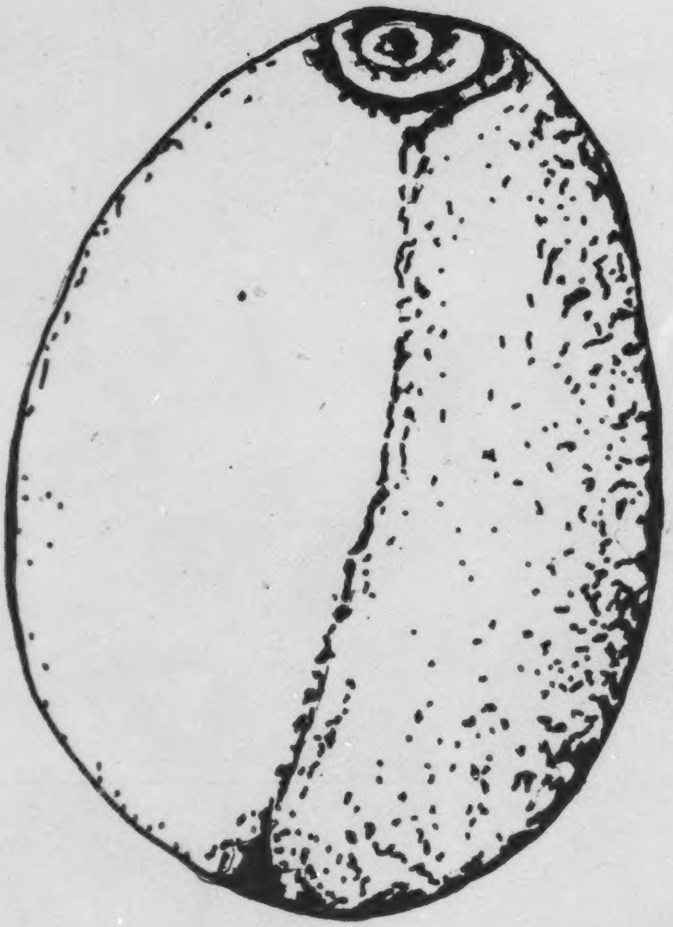
RUSSIAN KNAPWEED



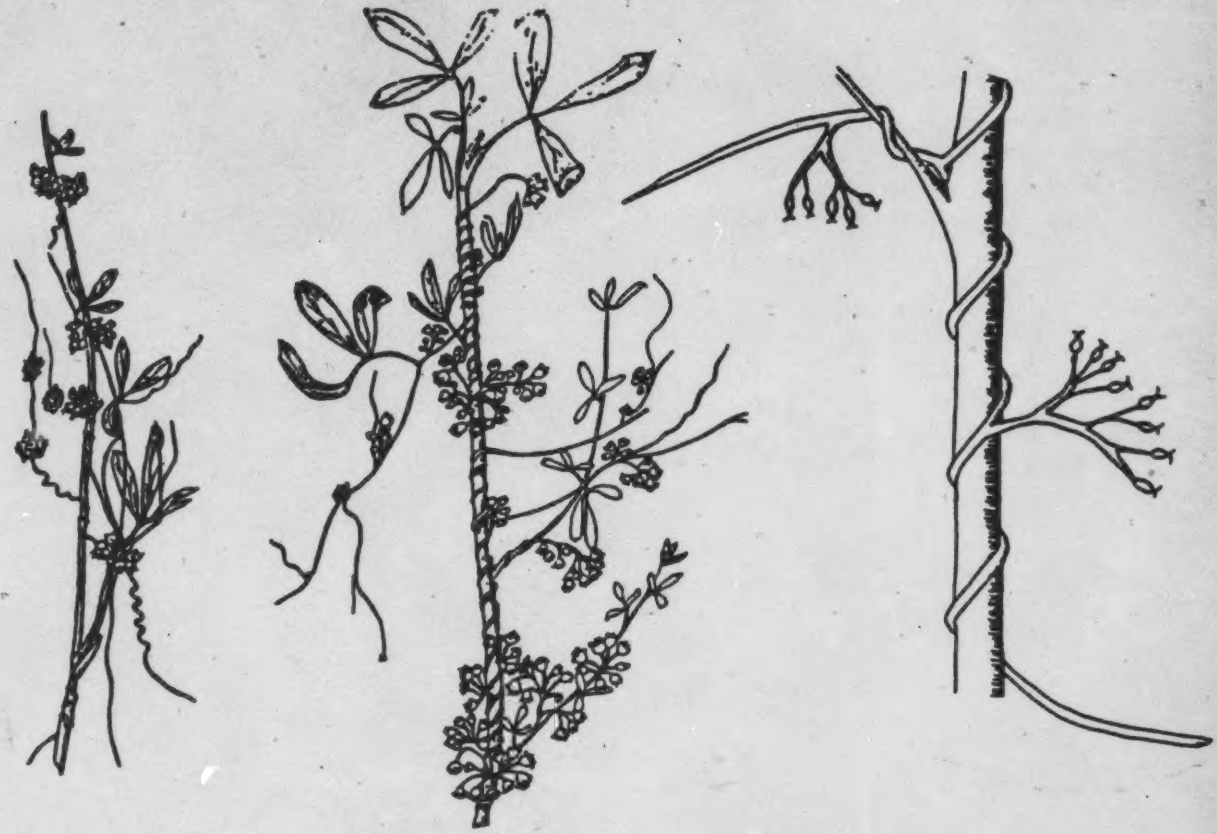
Courtesy of the Cooperative Extension Service, North Dakota State University.

DODDER SEED



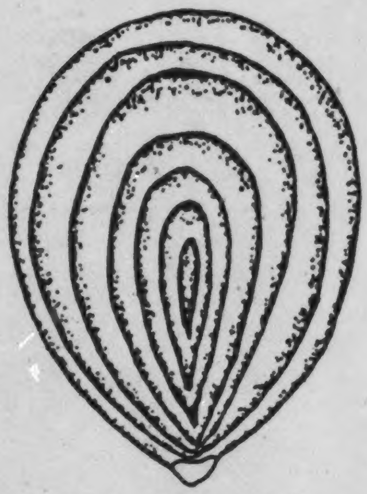
Courtesy of Washington State University, Pullman, Washington.

DODDER ON ALFALFA



Courtesy of Washington State University, Pullman, Washington.

FIELD PENNYCRESS SEED



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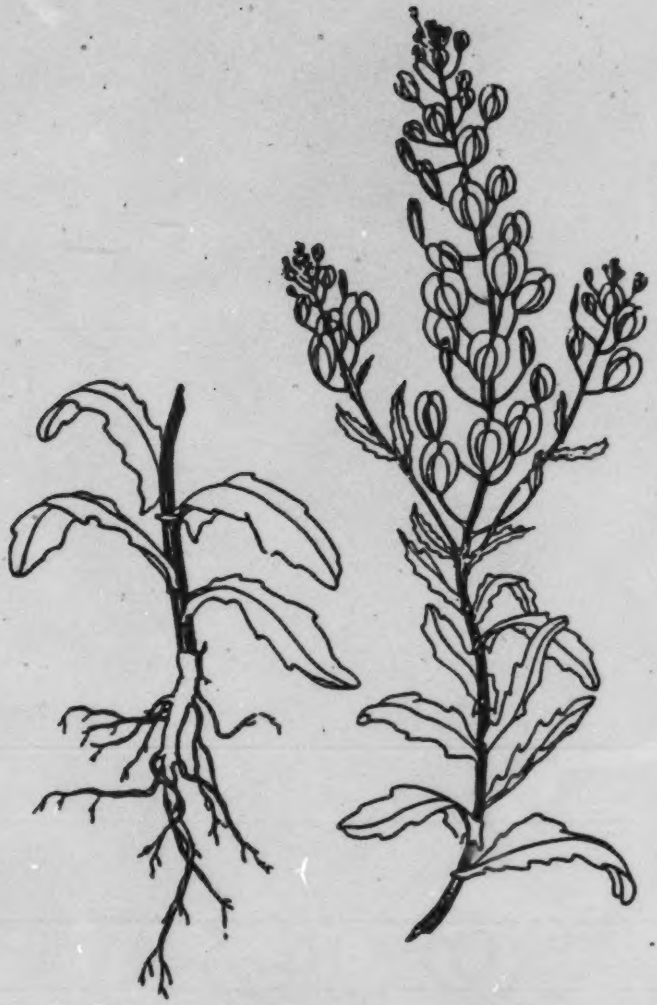
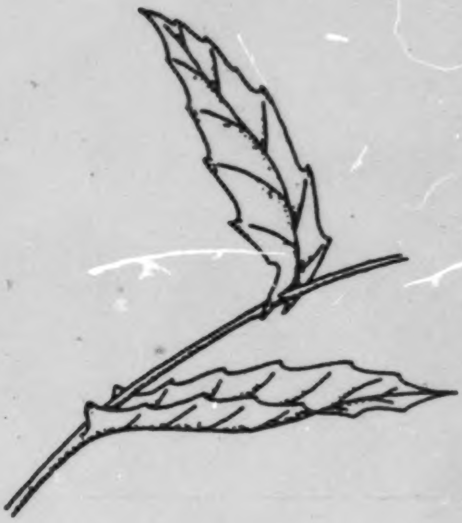
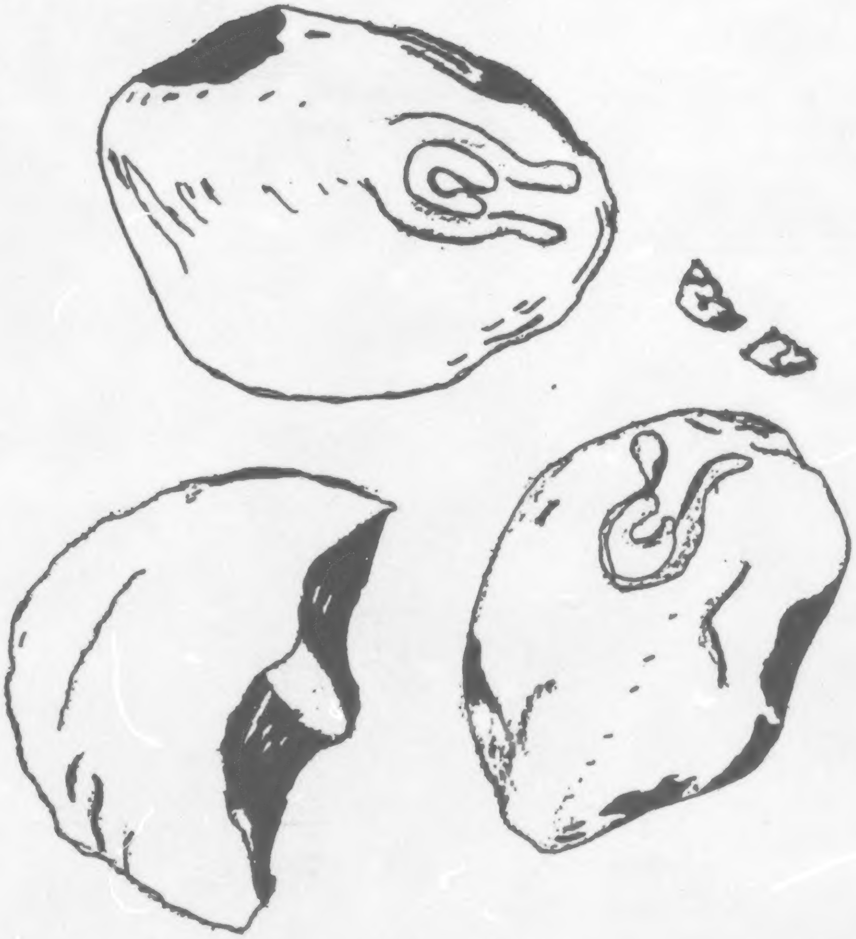
FIELD PENNYCRESS





Courtesy of Washington State University, Pullman, Washington.

HEDGE BINDWEED SEED



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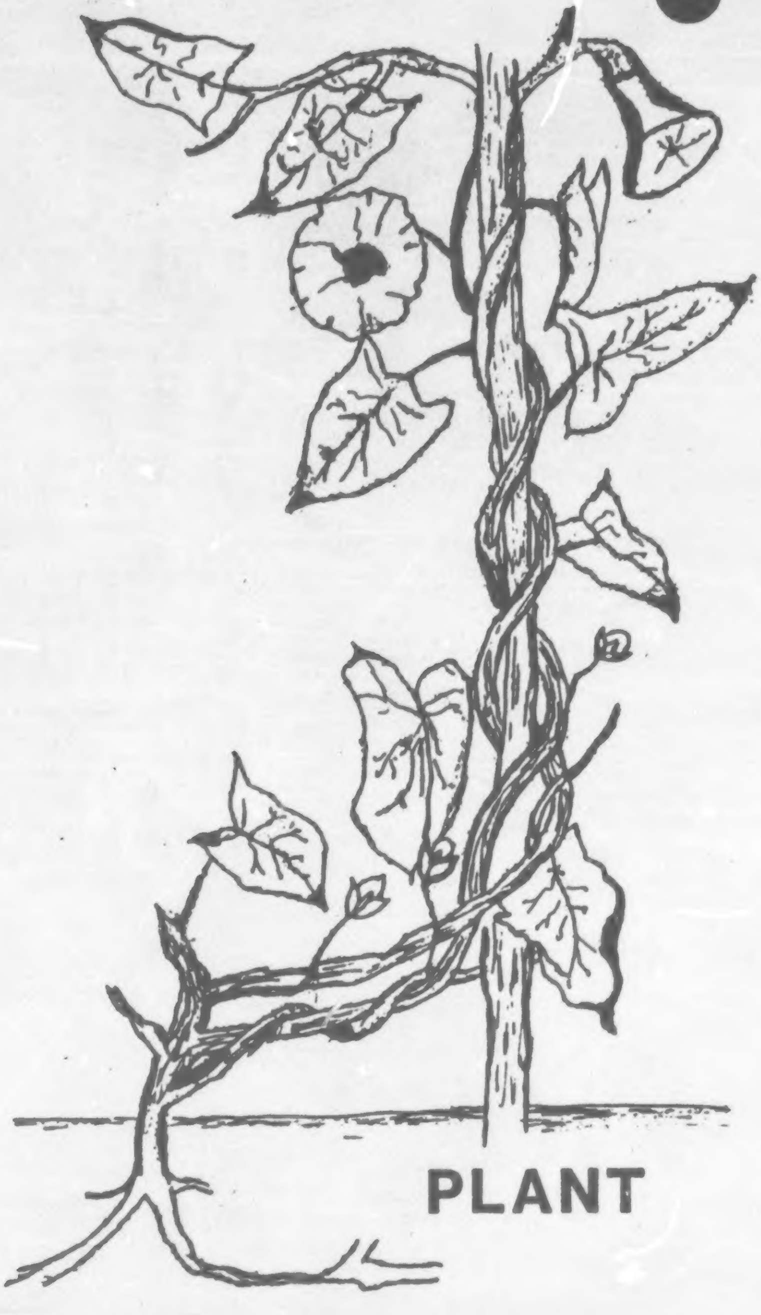
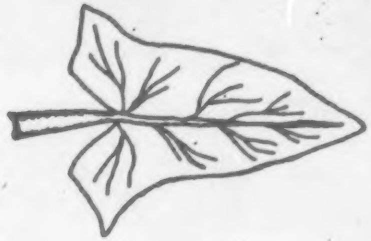
HEDGE BINDWEED



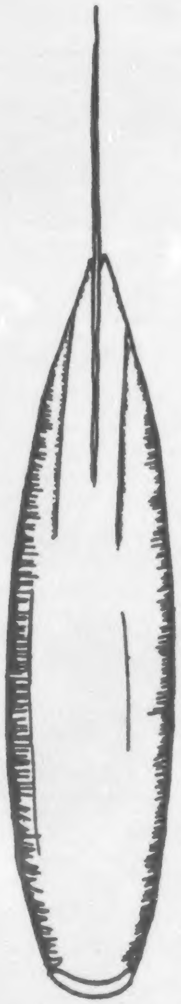
PLANT



LEAF

Courtesy of the Cooperative Extension Service, North Dakota State University.

QUACKGRASS SEED



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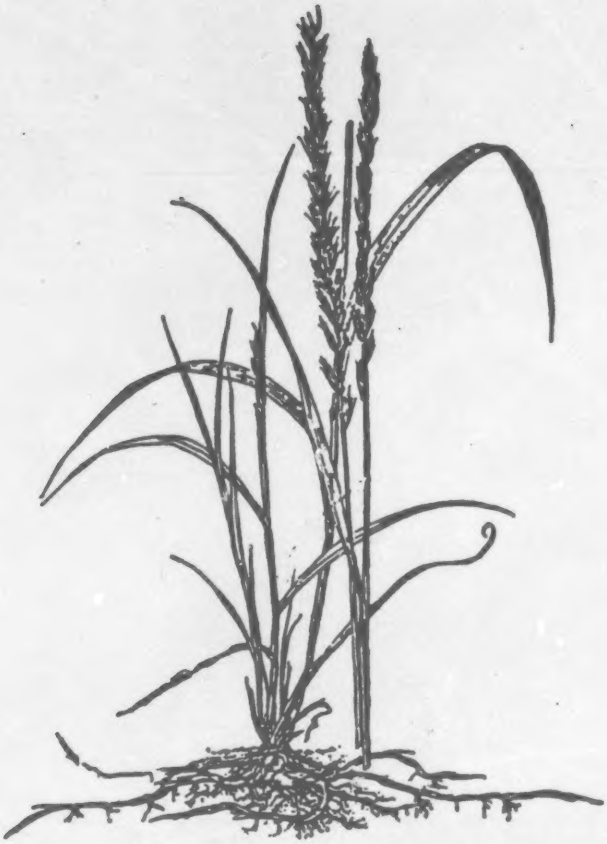
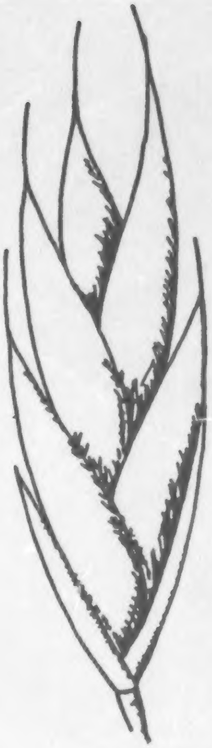
QUACKGRASS





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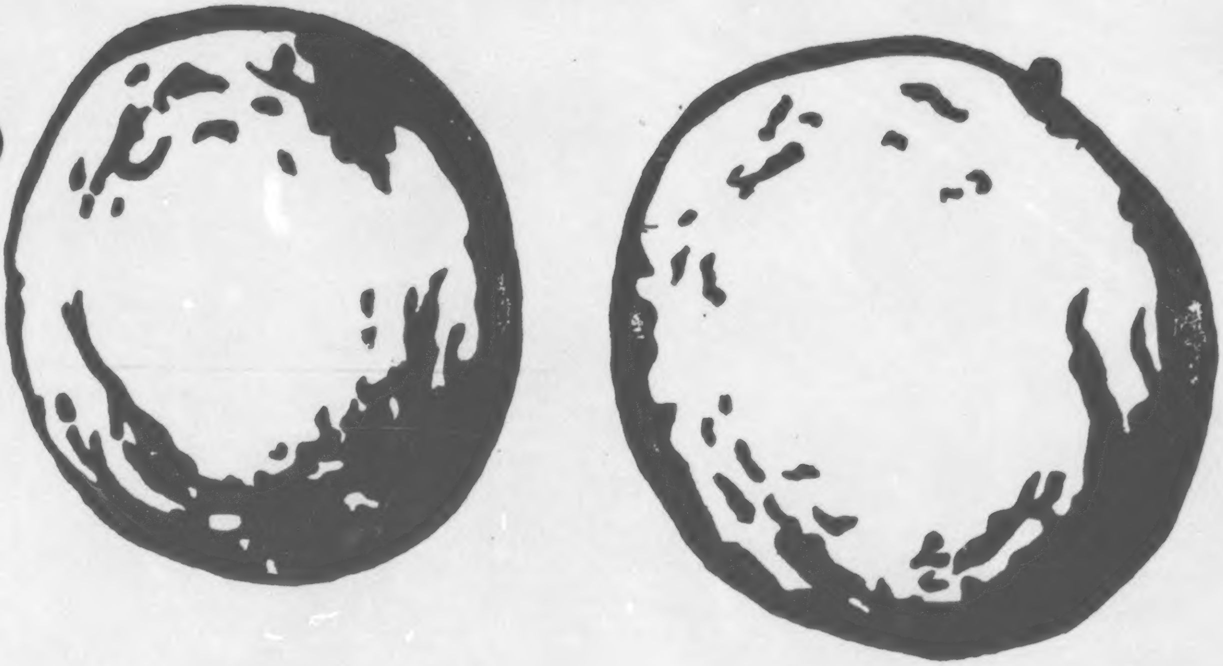
WILD MUSTARD SEED



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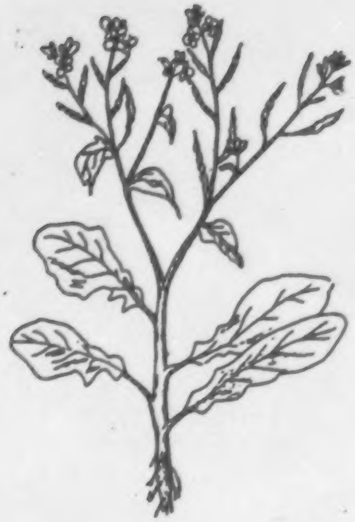
WILD MUSTARD PLANT



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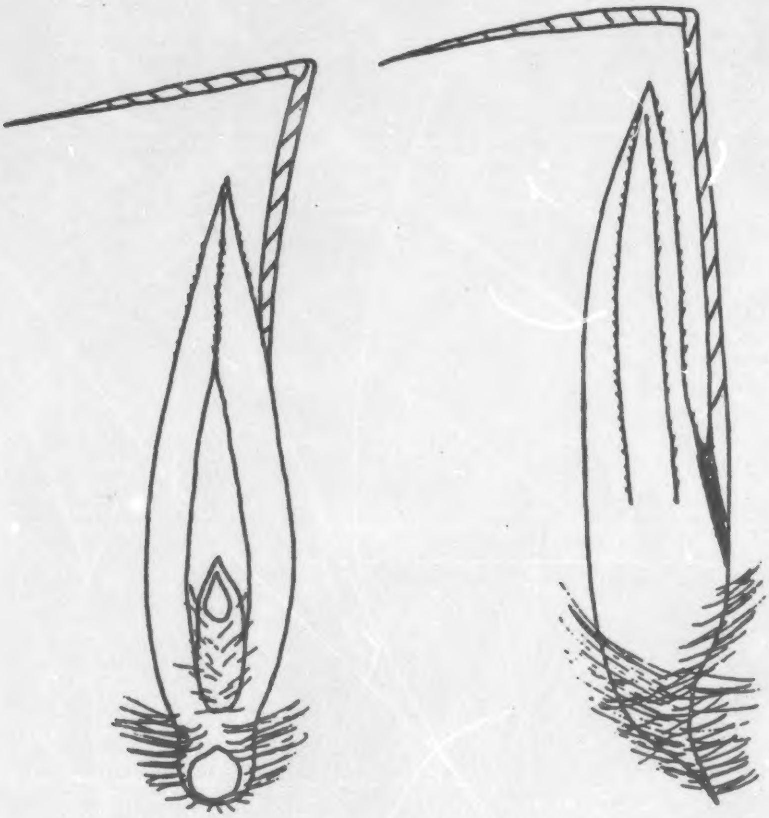
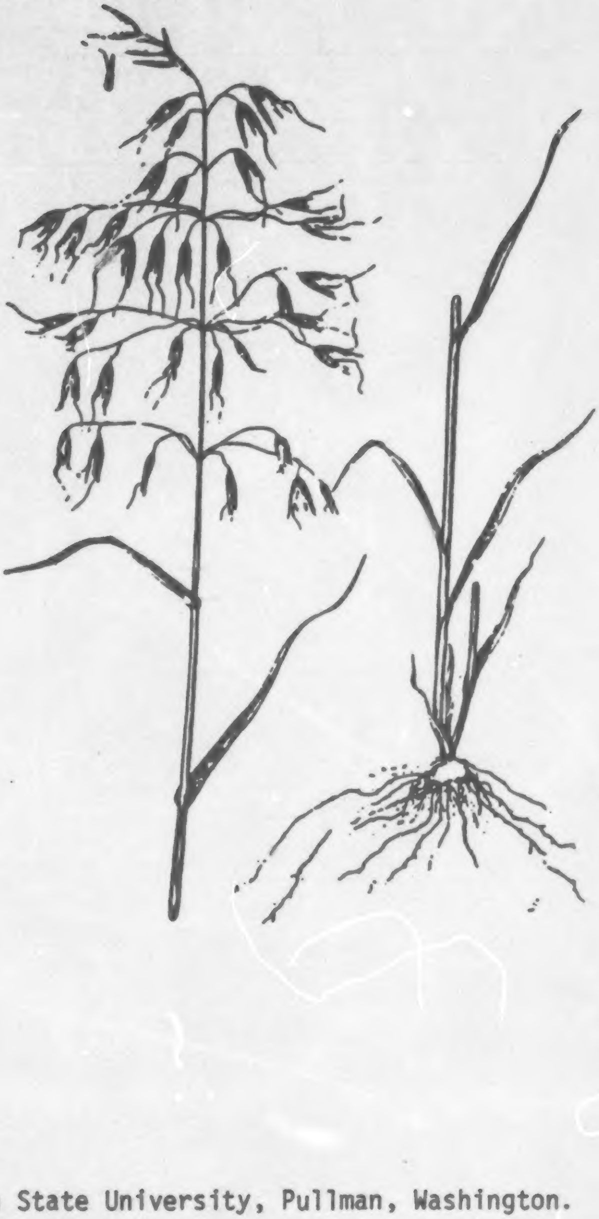
WILD OATS SEED



Courtesy of Washington State University, Pullman, Washington.

WILD OATS



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Job 5: Determining Seed Quality

Objectives:

The objectives of this job shall be met at a level predetermined by the instructor. The manner in which they are evaluated shall also be determined by the instructor.

Upon completion of this job, the student shall be able:

1. to list qualities of good seed.
2. to identify damaged and diseased seeds.
3. to identify weed and crop seeds, and inert material in seeds.
4. to rank factors by importance.
5. to judge classes of grain.

Guide Questions:

1. What are the qualities of good seed?
2. How are damaged and diseased seeds identified?
3. What foreign materials lower seed quality?
4. What factors are most important in determining seed quality?
5. How do you go about judging grain classes?

References:

Berglund, Duane R. Order and Importance of Crop Judging Factors in North Dakota. Cooperative Extension Service, North Dakota State University, Fargo, North Dakota.

Contests Awards and Activities Bulletin. North Dakota FFA Association, December 1977.

Dungan, George H. and W. A. Ross. Growing Field Crops. New York, New York: McGraw-Hill Book Company, Inc., 1957.

Messersmith, Calvin G. and Edward L. Deckard. Agronomy 103 Lecture Guide. Agronomy Department, North Dakota State University, Fargo, North Dakota, 1978.

Interest Approach:

Ask the students what kinds of things they might look for if they were going to buy a car. After naming a few, point out the necessity of knowing what to look for in anything you buy or use. Then ask for qualities to look for in seed, leading into the outline discussion.

Key Facts:

I. Qualities of Good Seed. (Transparency 1)

  A. Good variety.

    1. Adapted to the region

    2. High yield.

    3. Insect and disease resistant.

    4. Recommended by extension agent or other expert.

  B. Appearance.

    1. Uniform size, shape, and color.

    2. Plump kernels.

    3. Bright color.

  C. High germination.

    1. 95 percent generally considered adequate.

    2. Varies depending on the kind of crop.

    (Note: Germination will be covered more extensively in Job 6.)

  D. Free of damaged and diseased kernels.

  E. Free of other seeds and foreign matter.

II. Damaged and Diseased Kernels.

  A. Damaged.

    1. Immature and green kernels.

      a. Green or greenish tint.
      b. May be smaller than other kernels.
      c. Seeds do not germinate.

    2. Sprouted kernels.

      a. Seed coat ruptured.
      b. Sprout may have grown and broken off.

    3. Frosted kernels.

      a. Frost blisters
      b. Waxlike appearance.
      c. May be discolored.

    4. Broken kernels.

      a. Seeds are cracked or have seed coat damaged.
      b. Often caused by improper harvesting.

5. Excessive heating.
    a. Dark discoloration.
    b. Seeds may have been heat damaged without discoloring.
6. Excessive moisture.
    a. Seed is softer.
    b. May be lighter in color.
    c. Grain will heat and become musty.
7. Insect damage.
    a. Kernels may have dark specks.
    b. Kernels may have small holes or appear to have been chewed.

B. Diseased.

1. Stinking smut.
    a. Smut odor.
    b. Black spores.
    c. Found in wheat.
2. Black point.
    a. Blackish discoloration at end of seed.
    b. Found in wheat.
3. Scab.
    a. Discoloration ranges from white to grayish or pinkish.
    b. Kernels may be shriveled.
    c. Found in wheat and barley.
4. Blight.
    a. Brownish black blotch or streaked kernel.
    b. Found in barley and oats, occasionally wheat.
5. Ergot.
    a. Purplish gray-black body replaces kernel.
    b. Similar in shape to kernel.
    c. Found in wheat, barley, oats, and rye.

III. Foreign Matter.

A. Weed seeds.

1. Prohibited noxious weeds.
2. Restricted noxious weeds.

3. Other weed seeds.

B. Crop seeds.

1. Other crop seeds.

2. Other classes (Example: Durum in spring wheat).

C. Inert materials.

1. Soil or stones.

2. Sticks, chaff or straw.

3. Does not affect quality but adds bulk.

IV. Importance of Quality Factors. (Transparency 2)

(Note: Factors are ranked from most to least important.)

A. Prohibited noxious weed seeds.

B. Restricted noxious weed seeds.

C. Germination.

D. Other weed seeds.

E. Other crop seeds.

F. Contrasting classes.

G. Damaged seeds.

H. Diseases.

I. Appearance.

J. Inert material.

V. North Dakota Crops Judging Contests.

A. Contest segments.

1. Selection of grain seed, placings and reasons.

a. Hard red spring wheat, two classes.
b. Durum wheat.
c. Malting barley.
d. Oats.
e. Flax

2. Identification of crops and weeds.

    a. 15 seed samples.
    b. 15 plant mounts.

3. Market grain.
   (Note: Information for this section has not been included in this unit.)

    a. Hard red spring wheat factors.
    b. Malting barley factors.
    c. Market grade description and evaluation of spring wheats.

B. Steps in judging seed classes. (Transparency 3)

1. Write your contestant number in the space provided.

2. Write the kind of grain to be judged following the word "Class".

3. Write the sample numbers in order from top to bottom under "Sample No."

4. Examine each sample and list the factors you find under "Reasons".

    a. May be none, 1, 2, or 3 factors.
    b. If none, list as "Pure" or "Clean".
    c. Use specific terms to identify the factors. General terms such as "noxious weeds", "diseased", or "damaged" are not acceptable.
    d. There must be six of any item to be considered a factor.
    e. Use the eraser end of your pencil to move seeds around. Never use the point as it will leave marks.

5. Continue to next sample when instructed and again examine for factors. Continue in the same manner until all 4 samples have been inspected.

6. Place the class according to the most serious factor found in each sample. Other factors do not matter.

7. Review your card to make sure it is completely filled out.

8. Continue to next class.

C. Steps in plant and seed identification.

1. Write your contestant number on the card.

2. Examine the plant or seed sample.

3. Write down the name of the sample. Only complete and proper names will be accepted, such as "Barley - six row".

4. Continue to the next sample when instructed.

D. Contest rules.

1. 10-12 minutes usually allowed per class.

2. No talking allowed.

3. If caught cheating, you will be disqualified.

4. Use pencils only, NO pens allowed.

5. If you spill grain from a dish do not put it back into dish, ask the floor leader to take care of it.

6. No clip boards, notes, or crop manuals are allowed to be carried by the contestant.

Student Learning Activities:

1. Have students examine examples of diseased and damaged kernels.

2. Have students obtain grain samples and then inspect each other's samples. Save the samples for use in Job 6.

3. Have the students complete the enclosed worksheet.

4. Conduct a crops judging workout.

Worksheet #1

Complete final placings on the following classes:

CLASS I: Durum

Final Placing:

First ____ Second ____ Third ____ Fourth ____

Sample No.	Reasons
11	Blackpoint
12	Pure
13	Cracked Kernels & HRS Wheat
14	Leafy spurge & quackgrass

CLASS II: Malting Barley

Final Placing:

First ____ Second ____ Third ____ Fourth ____

Sample No.	Reasons
21	Skinned & Broken
22	Hedge & Field bindweed
23	HRS wheat & durum
24	Stones & Wild Rose

CLASS III: Malting Barley

Final Placing:

First ____ Second ____ Third ____ Fourth ____

Sample No.	Reasons
31	Giant ragweed & Common ragweed
32	Pure
33	Oats & Skinned & Broken
34	Quackgrass & Field pennycress

CLASS IV: Oats

Final Placing:

First ____ Second ____ Third ____ Fourth ____

Sample No.	Reasons
41	Barley & Russian knapweed
42	Hulled oats & rye
43	Pure
44	Wild oats & giant ragweed

CLASS V: Oats

Final Placing:

First ____ Second ____ Third ____ Fourth ____

Sample No.	Reasons
51	Wild oats & Wild mustard
52	Blight, stones
53	Canada thistle
54	Wheat & Barley

CLASS VI: Wheat

Final Placing

First ____ Second ____ Third ____ Fourth ____

Sample No.	Reasons
61	Alfalfa
62	Leafy spurge & Green foxtail
63	Wild buckwheat
64	Sunflower & Wild mustard

CLASS VII: Flax

Final Placing:

First ____ Second ____ Third ____ Fourth ____

Sample No.	Reasons
71	Perennial sowthistle & Cracked
72	Frost damage & Low germination
73	Yellow foxtail & Barnyardgrass
74	Chaff

CLASS VIII: Durum

Final Placing:

First ____ Second ____ Third ____ Fourth ____

Sample No.	Reasons
81	HRS Wheat
82	Barley
83	Starchy & Broken kernels
84	Frost, Blackpoint & Field bindweed

Courtesy of the Cooperative Extension Service, North Dakota State University

Answer Key to Worksheet #1

Complete final placings on the following classes:

CLASS I: Durum

Final Placing:

First 12 Second 11 Third 13 Fourth 14

Sample No.	Reasons
11	Blackpoint
12	Pure
13	Cracked Kernels & HRS Wheat
14	Leafy spurge & quackgrass

CLASS II: Malting Barley

Final Placing:

First 21 Second 23 Third 24 Fourth 22

Sample No.	Reasons
21	Skinned & Broken
22	Hedge & Field bindweed
23	HRS wheat & durum
24	Stones & Wild Rose

CLASS III: Malting Barley

Final Placing:

First 32 Second 33 Third 31 Fourth 34

Sample No.	Reasons
31	Giant ragweed & Common ragweed
32	Pure
33	Oats & Skinned & Broken
34	Quackgrass & Field pennycress

CLASS IV: Oats

Final Placing:

First 43 Second 42 Third 44 Fourth 41

Sample No.	Reasons
41	Barley & Russian knapweed
42	Hulled oats & rye
43	Pure
44	Wild oats & giant ragweed

CLASS V: Oats

Final Placing:

First 52 Second 54 Third 51 Fourth 53

Sample No.	Reasons
51	Wild oats & Wild mustard
52	Blight, stones
53	Canada thistle
54	Wheat & Barley

CLASS VI: Wheat

Final Placing

First 61 Second 63 Third 64 Fourth 62

Sample No.	Reasons
61	Alfalfa
62	Leafy spurge & Green foxtail
63	Wild buckwheat
64	Sunflower & Wild mustard

CLASS VII: Flax

Final Placing:

First 74 Second 73 Third 72 Fourth 71

Sample No.	Reasons
71	Perennial sowthistle & Cracked
72	Frost damage & Low germination
73	Yellow foxtail & Barnyardgrass
74	Chaff

CLASS VIII: Durum

Final Placing:

First 83 Second 81 Third 82 Fourth 84

Sample No.	Reasons
81	HRS Wheat
82	Barley
83	Starchy & Broken kernels
84	Frost, Blackpoint & Field bindweed

QUALITIES OF GOOD SEED

1. RECOMMENDED VARIETY
2. UNIFORMITY AND APPEARANCE
3. HIGH GERMINATION
4. NO DAMAGED OR DISEASED KERNELS
5. NO OTHER CROP OR WEED SEEDS OR FOREIGN MATTER

ORDER OF IMPORTANCE IN SEED SELECTION

1. PROHIBITED NOXIOUS WEED SEEDS
2. RESTRICTED NOXIOUS WEED SEEDS
3. LOW GERMINATION
4. OTHER WEED SEEDS
5. OTHER CROP SEEDS
6. CONTRASTING CLASSES
7. DAMAGED KERNELS
8. DISEASED KERNELS
9. APPEARANCE
10. INERT MATERIAL

C Judging Bb-13

SEED GRAIN CLASS SCORE CARD

Placings ____________________
Reasons ____________________
Score ____________________

Contestant's Number ____________________

Final Placing

First __________ ; Second __________ ; Third __________ ; Fourth __________

Class:

Sample No.	Reasons

144

A-7-5
TM 3

Job 6: Preparing Seed for Planting.

Objectives:

The objectives of this job shall be met at a level predetermined by the instructor. The manner in which they are evaluated shall also be determined by the instructor.

Upon completion of this job, the student shall be able:

1. to recognize the importance of seed preparation.
2. to understand why and how seed is cleaned.
3. to conduct a germination test and determine germination percentage.
4. to understand why and how seed is treated.
5. to understand why and how seed is inoculated.

Guide Questions:

1. Why and how is seed cleaned?
2. How is a germination test conducted?
3. Why and how is seed treated?
4. Why and how is seed inoculated?

References:

Delorit, Richard J., Louis J. Greub and Henry L. Ahlgren. Crop Production. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1974.

Dungan, George H. and W. A. Ross. Growing Field Crops. New York, New York: McGraw-Hill Book Company, Inc., 1957.

Messersmith, Calvin G. and Edward L. Deckard. Agronomy 103 Laboratory Guide. Agronomy Department, North Dakota State University, Fargo, North Dakota, 1976.

Interest Approach:

Ask the students if they remember what happened to the trail of crumbs left by the two children in the story of Hansel and Gretel. Point out how it is similarly wasteful to plant seed which has not been properly prepared by cleaning and treating.

Key Facts:

I. Cleaning Seed.

A. Purposes.

1. To remove undesirable weed seeds.

2. To remove undesirable crop seeds.

3. To remove diseased and damaged kernels.

4. To remove inert material.

B. Method.

1. Screens.

   a. Removes materials larger or smaller than seed size.
   b. Materials similar in size and shape remain in seed.

2. Fans.

   a. Removes light materials, chaff and small seeds.
   b. Materials of similar weight remain in seed.

3. Many special machines and methods used for removing certain weeds or diseased kernels from seed.

4. Generally processed using two or more methods.

5. Done by hand for contests.

II. Germination Test.

A. Requirements for germination.

1. Water.

2. Proper temperature.

   a. Ranges from about 5 - 30 degrees C (40 - 85 F).
   b. Optimum is about 22 degrees C (70 F).
   c. Varies with different crops.

3. Oxygen.

B. Methods.

1. Ragdoll test.

   a. Materials needed.

      1) Paper towel.
      2) Wax paper.
      3) Known number of seeds to be tested.

b. Procedure.

1) Soak the paper towel in water, squeeze out the excess moisture, and lay the towel on top of the wax paper.
2) Place the seeds on top of the paper towel in an orderly manner.
3) Roll the paper towel and wax paper up so the wax paper will retain the moisture in the doll. (Transparency 1)
4) Staple each end of the rag doll.
5) Allow the seeds to germinate at an appropriate temperature for an appropriate length of time, 5 to 7 days for most crop plants.
6) Count the number of germinated seeds. Both the shoot and the root must be visible.
7) Divide the number of germinated seeds by the total number to determine the percentage.

2. Blotter test.

a. Materials needed.

1) Blotter.
2) Known number of seeds to be tested.

b. Procedure.

1) Soak the blotter in water and squeeze out the excess moisture.
2) Place the seeds on 1/2 of the blotter in an orderly manner.
3) Fold the remaining 1/2 of the blotter over the seeds and press slightly.
4) Staple the edges of the blotter together.
5) Allow to germinate at an appropriate temperature for an appropriate length of time, 5 to 7 days for most crop plants, under conditions in which the blotter will remain moist.
6) Count the number of germinated seeds. Both shoot and root must be visible.
7) Divide the number of germinated seeds by the total number to determine the percentage.

3. Important to use a random sample of seed.

III. Treating Seed.

A. Purpose.

1. Keeps fungus found on seed and in soil from deteriorating the seed.

2. Helps to increase stand.

B. Method.

1. Fungicide is mixed with the seed.
2. Usually in a powder form.

IV. Inoculating Seed.

A. Purpose

1. Done only with legumes.
2. Attaches beneficial bacteria to the seed.
3. Produces nitrogen for the plant.
4. Not necessary if bacteria already present in the soil from legumes grown previously.

B. Method.

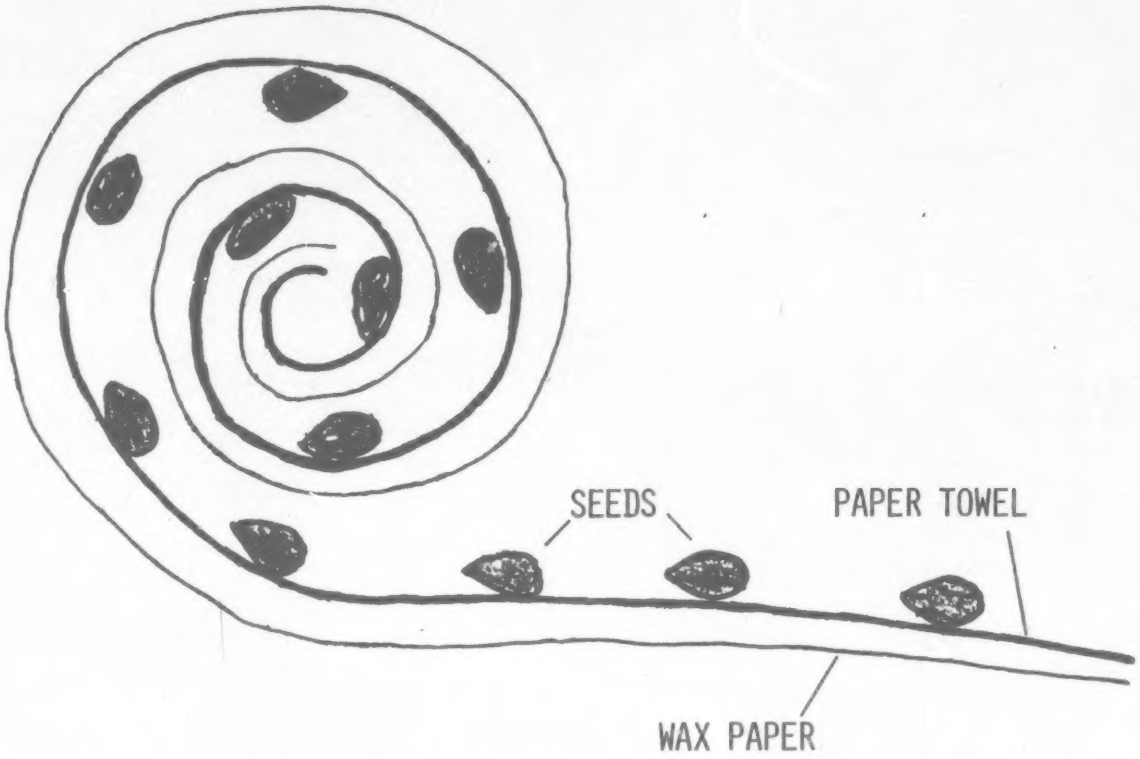
1. Bacteria in solution is mixed with the seed.
2. Seed should be planted as soon as possible after inoculating.
3. Must dry first to avoid damage in the planter.

Student Learning Activities:

1. Have the students clean the seed samples they brought in Job 5. Try to get the students interested in exhibiting at a crop show if they have a crop production project.
2. Give the students sample numbers of seeds in germination tests to practice calculating percentage. Also have them calculate the number of corn seeds not germinating in a 16 hectare (40 acre) field at 95% germination if a seeding rate of 12 kg/ha (.2 bu/a) is used. There are 3270 kernels/kg (83,000/bu). The answer should be 31,392 in 16 ha (33,200 in 40 a).
3. Have the students conduct a germination test using the Ragdoll and/or the Blotter method. They should calculate the germination percentage.
4. Have the students tour a local seed plant or elevator to observe cleaning and treating procedures.
5. Show either of the following films available from the North Dakota State Film Library.

   How Seeds Sprout
   Seed Germination

ROLL THE RAGDOLL UP SO THE
WAX PAPER RETAINS THE MOISTURE


SEEDS
PAPER TOWEL
WAX PAPER